PROSTHODONTICS
PROF. SAJID NAEEM
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FOR UNDERGRADUATE AND POSTGRADUATE STUDENTS

This book is prepared with the help of following books

Prosthodontic Treatment for Edentulous Patients
by ZARB. HOBKIRK. ECKERT. JACOB

McCracken's
Removable Partial Prosthodontics
By ALAN B. CARR.
DAVID T. BROWN

Prosthetic Treatment of the Edentulous Patient
R M BASKER.
J C DAVENPORT.
H R TOMLIN

Stewart's clinical
Removable Partial Prosthodontics
RODNEY D. PHOENIX
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Contemporary Implant Dentistry
CARL F. MISH

Phillip's Science of Dental Materials

Complete Dentures and Overdentures Prosthetics
ALFRED H. GEERING
ARTIM KUNDERT
CHARLES C. KELSEY

Designing Complete Dentures
DAVID M WATT
A ROY MacGregor

And many Web. Sites for figures.

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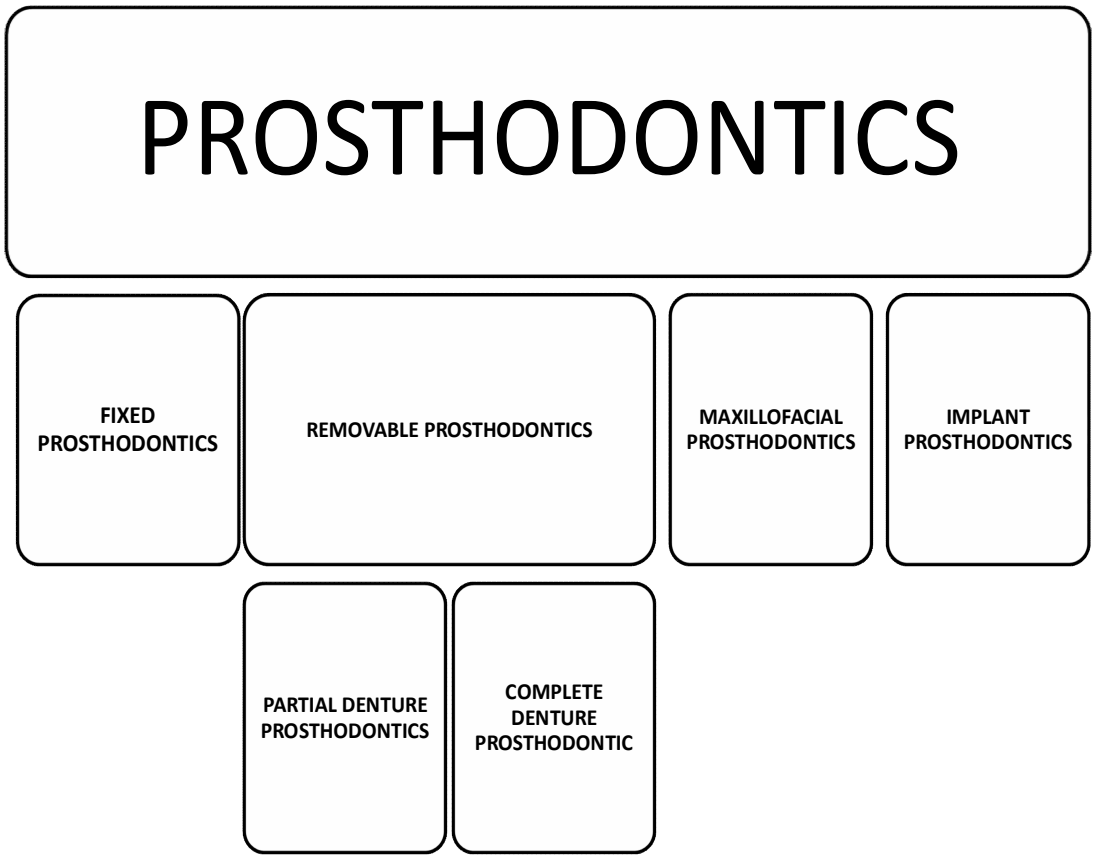
PROSTHODONTICS

The art and science of dentistry deals with the replacement of acquired and congenital loss of tooth and tissue in oral and maxillofacial region to restore function, esthetics and phonetics.



TREATMENT PLANNING FOR EDENTULOUS PATIENT

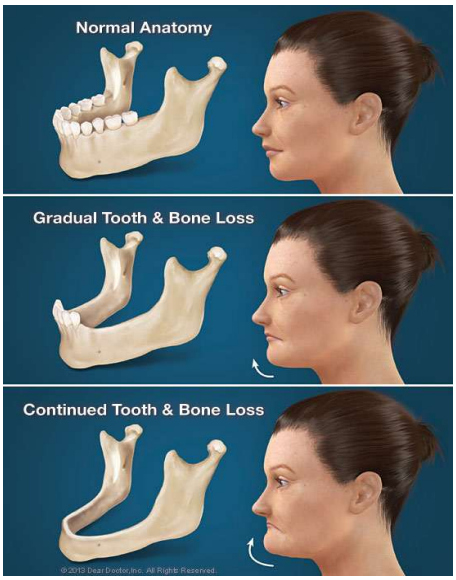
EDENTULISM

Edentulism, defined as the complete loss of all dentition, is a worldwide phenomenon. Edentulism occurs because of biologic disease processes, such as dental caries, periodontal diseases, trauma, and oral cancer. Edentulism is accompanied by several comorbidities that can significantly influence an individual. Although the rate of edentulism is declining, the number edentulous patients continue to rise because of the increase in population.

CONSEQUENCES OF EDENTULISM

CONSEQUENCES ON BONY STRUCTURES

Bone needs stimulation to maintain its form and density. Teeth transmit compressive and tensile forces to the surrounding bone. Once a tooth is lost, the lack of stimulation to the residual bone causes a loss of bone density, height width and volume in that area.
A removeable prosthesis does not stimulate and maintain bone rather it accelerated the bone loss. As masticatory load transmitted to the surface of the bone only, not the whole bone, as by the natural tooth. As a result, blood supply reduces and the total bone volume loss occurs.

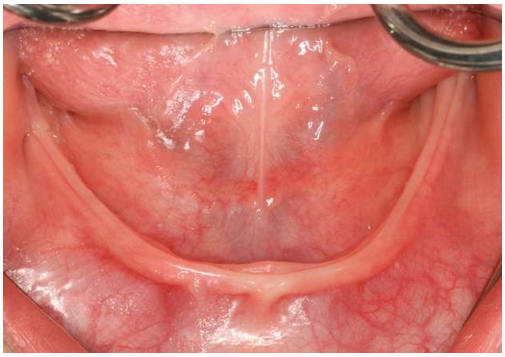


The continuous bone loss leads to atrophic edentulous ridges. This continuous atrophy causes exposure of other bone structures to denture base as mylohyoid ridge, external oblique ridge, genial tubercles, anterior nasal spine, which have thin mucosa coverage and great discomfort to patients.
Further bone loss in mandible also exposes the mental foramen and its contents leads to acute pain and paresthesia during chewing. The increase bone loss also causes mandible fracture even under very low impact. In maxilla complete anterior ridge and even anterior nasal spine may also resorbed causes pain and denture movement, due to loss of lip support, during function.

CONSEQUENCES ON SOFT TISSUE

With the loss of bone height and width the attached gingiva gradually decreases. This attached gingiva is keratinized tissue and can resist the abrasions caused by hard denture bases. The un-keratinized tissue which replaces the attached gingiva is prone to abrasion caused by denture base. The loss of thickness of the attached gingiva lost cushion effect under dentures. The thickness of gingival tissues also

effected by the systemic diseases and physiological changes related to aging as diabetes, anemia mal nutrition etc.



The tongue with edentulous ridges often enlarges to accommodate the increase in space formally occupied by the teeth and take a more active role in mastication. As a result, the prosthesis lost its stability. The decrease in neuromuscular control due to aging also increase the problem. With increasing age to learn motor skills also reduced.

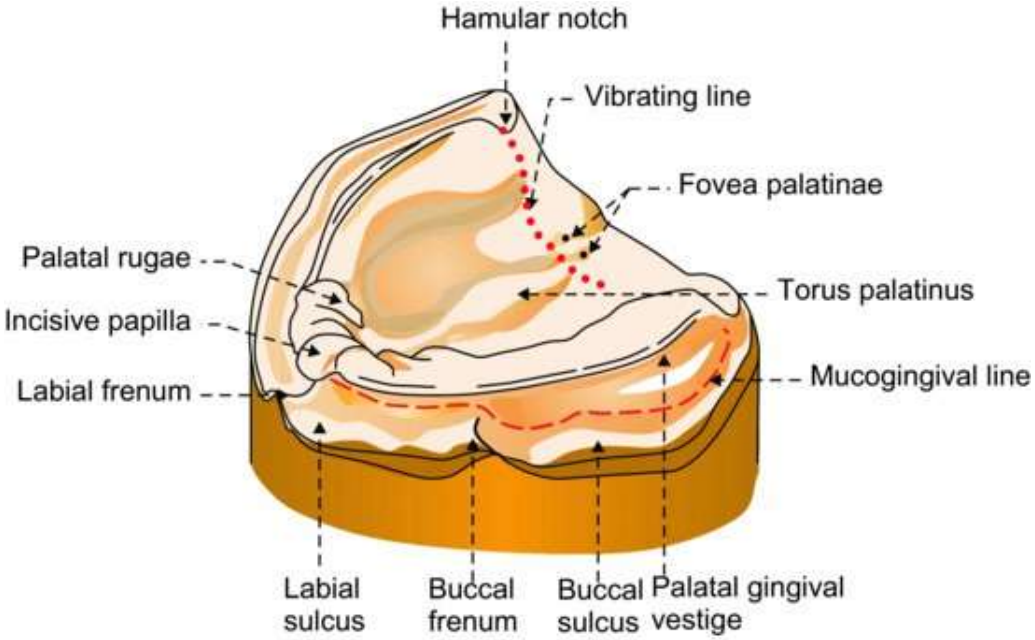
CONSEQUENCES ON ESTHETICS

A decrease in facial height due to loss of teeth and collapsed vertical dimension causes severe facial changes. The loss of labiomental angle and deepening of vertical lines creates a harsh appearance. The vertical height of lower face progressively decreases and leads to a pseudo class III occlusion. As a result, the chin rotates forward and creates a prognathic appearance. With the loss of muscle tone this looks like a witch-chin.

BONY STRUCTURES CHANGES	SOFT TISSUES CHANGES	ESTHETICS CHANGES
Decrease width and height of supporting bone Prominent mylohyoid ridge, genial tubercles Muscles attachment near crest of ridge Reduced vertical height Loss of anterior ridge and nasal spine Increased fracture chances of mandible Exposure of mental foreman	Loss of attached gingiva Loss of keratinized mucosa Thinning of mucosa over ridges Enlargement of tongue Decrease neuromuscular control	Looseness of facial muscles Deepening of nasolabial fold Loss of labiodental fold Decrease horizontal labial angle Increase columella philtrum angle Decrease facial height Thinh of vermilion boarder Increase length of upper lip Ptosis of buccinator muscle Ptosis of mentalis muscle Prognathic appearance

APPLIED ANATOMY

MAXILLARY ARCH



INCISIVE PAPILLA

It is a soft tissue projection on the palatal side between the two central incisors. The incisive papilla covers the incisive foramen on hard palate, which carries the nasopalatine vessels and nerves. The incisive papilla is used for mid line demarcation. It is also helpful in selection and setup of teeth, in defining arch shape, determining bone resorption, adjusting vertical dimension.

LABIAL FRENUM

It is a fold of soft tissue at the mid line and attaches the lip with the alveolar ridge. It contains no muscle and has no action of its own.

BUCCAL FRENUM

It is a fold of soft tissues found in the premolar areas. The area between the two buccal frena (right & left) are called labial sulcus. The part of the denture, which occupies the labial sulcus, is called labial flange. There is an attachment of muscle under buccal frenum i.e. levator anguli oris this muscle moves forward and backward with facial muscles so dentures need space for it and should be recorded by functional movements of cheeks.

ZYGOMATIC PROCESS

A deep bony convexity is present behind the buccal frenum in buccal sulcus. This is the zygomatic process of maxillary bone. It creates a deep or shallow concavity in the denture flange depending on level of bone resorption. The buccinators muscle attaches with it and should not be displaces by the denture flanges.

MAXILLARY TUBEROSITY

It is a bony projection at the distal most corner of the maxillary arch on both sides. It provides stability to dentures. Few times it has undercuts on buccal sides which need surgery if severe. The coronoid process of mandible moves parallel to the tuberosity and limits the space for denture flange thickness.

PTERYGOMAXILLARY (HAMULAR) NOTCH

The hamular notch is situated between the maxillary tuberosity and hamular process of medical pterygoid plate. It is a depression behind the maxillary tuberosity. It is the laterio posterior last extension of the denture. The space between the buccal frenum and hamular notch is called buccal flange of the denture.

PALATINE FOVE

The fovea palatines are two depressions present both side of the midline of the posterior part of the palate. It is the opining of several mucous gland ducts. It helps to determine the posterior extension of the denture.

VIBRATING LINE OF SOFT PALATE

It is an imaginary line across the soft palate from one hamular notch to other hamular notch passing near fovea palatine at midline. It marks the beginning of motion in the soft palate when patient say "ah". It is the posterior end of the upper denture and posterior limit of post dam area.

MID PALATAL SUTURE

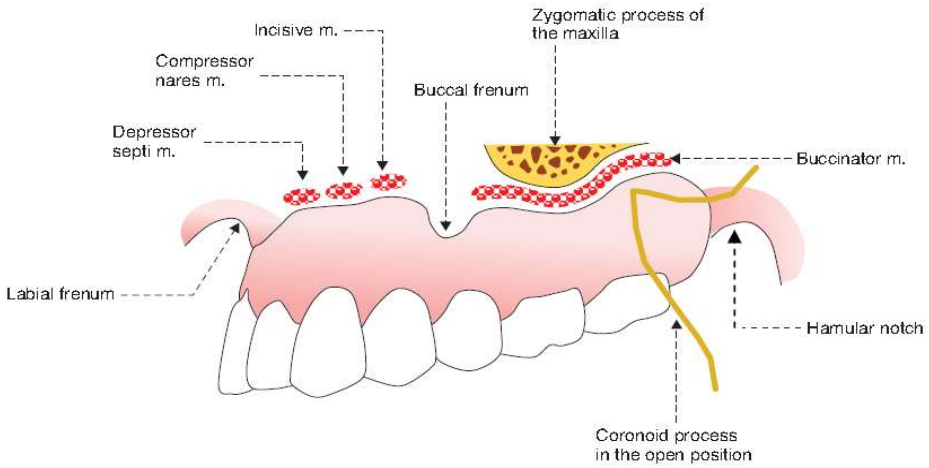
It is the union of both side of hard palate. The mucosa cover on it is of thin type and sometime bony elevations also seen need relief in dentures.

RUGAE

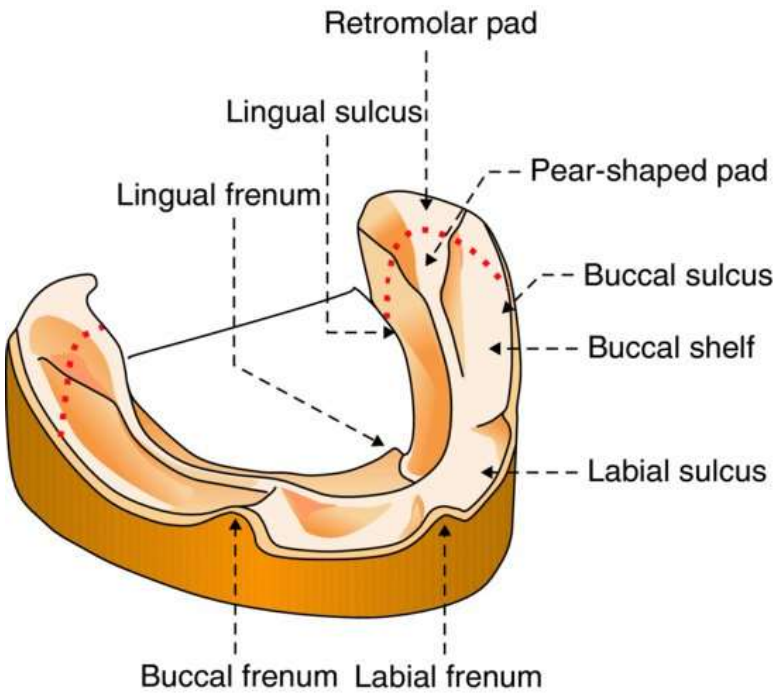
These are the fibrous bands in the anterior hard palate. They provide a good support to dentures.

PALATAL GINGIVAL VESTIGE

It is a cord like band of tissues present on the upper edentulous ridge. It is the remnants of lingual gingival margins. It is used is as a reference of natural tooth positions. It is also used in the making of biometric impression tray.



MANDIBLE ARCH



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BUCCAL SHELF

This is an area in the buccal sulcus. Its anterior is buccal frenum, on medial is crest of ridge, on lateral side is external oblique ridge and posterior is retro molar pad. In this area the buccinators muscle attach in horizontal direction and provide a platform on which denture can be extended.

RETRO MOLAR PAD

It is a triangular soft tissue pad at the distal end of the lower ridge. It is found in retro molar fossa, which is formed when external oblique ridge and internal oblique ridges converge towards the ramus of mandible. It is the last extension of lower denture. On its posterior boarder the ptyrego mandibular raphe is attached which limits the any posterior denture extension. The anterior 2/3 of the retro molar pad should be covered by denture.

MASSETER NOTCH

At the disto buccal corner of the sulcus the masseter muscle makes a projection in the sulcus during contraction. This makes a notch in denture boarder and called masseter notch. This is the only place where any muscle of mastication comes in contact with denture.

LINGUAL SULCUS

It can be divided in three parts.
Anterior lingual sulcus, medial and posterior lingual sulcus

LINGUAL FRENUM

It is a fold of soft tissues which attaches the tongue with the lingual side of the mandible in the mid line. It is very active during tongue movements.

GENIAL TUBERCLES

They are the bony projection on the anterior mandible on lingual side have muscle attachments geniohyoid and genioglossal. Few times due to severe bone resorption they come near the crest of ridge and needs special attention.

SUBLINGUAL GLAND

It is found in premolar region in middle lingual sulcus. Due to this the denture flange becomes narrow in pre molar area.

PREMYLOHYOID FOSSA

Posterior to sub lingual gland a depression is found due to the elevation of mylohyoid ridge on the body of mandible. This is called pre mylohyoid fossa and on denture it is pre mylohyoid eminence.

MYLOHYOID RIDGE

In the molar region of middle lingual sulcus, a bony ridge is found on the mandible. This is the place of mylohyoid muscle attachment. In severe resorption cases it becomes prominent in mouth and also tender on palpation.

POSTMYLOHYOID FOSSA

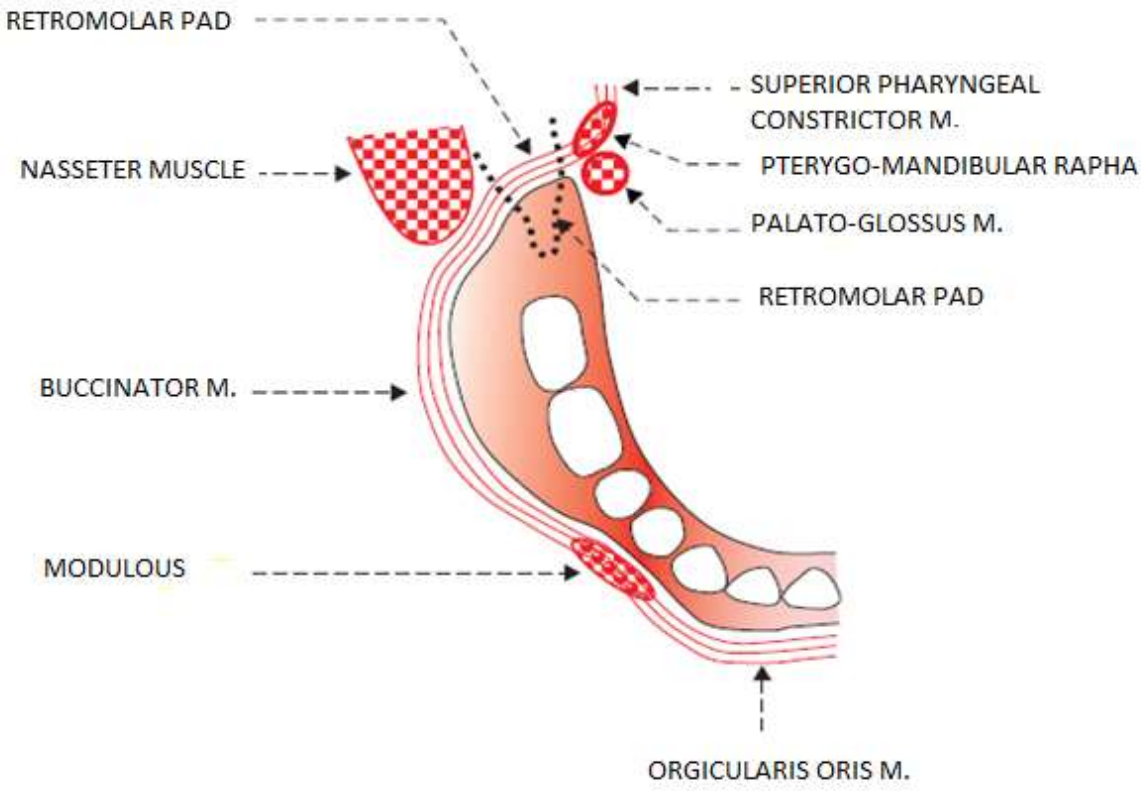
Posterior to mylohyoid ridge a depression is found due to the elevation of mylohyoid ridge on the body of mandible. This is called post mylohyoid fossa and on denture it is post mylohyoid eminence.

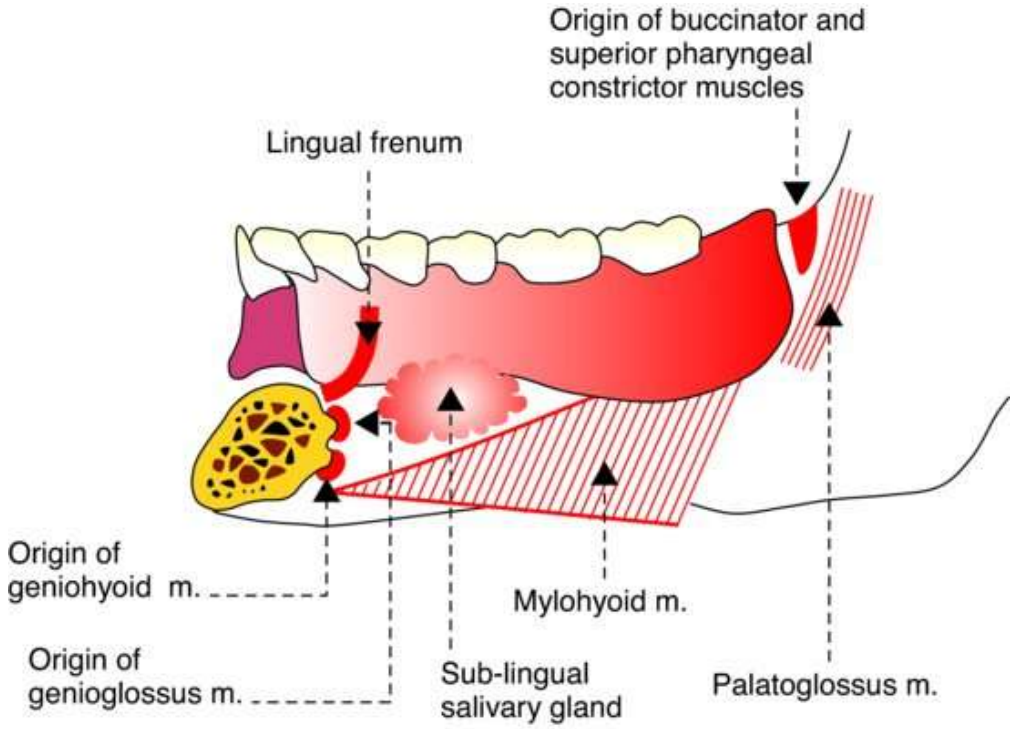
RETROMYLOHYOID FOSSA

In the posterior lingual sulcus posterior to the mylohyoid ridge a deep concavity is formed as the mylohyoid turn down ward and back ward from mylohyoid ridge. The concavity is called retomylohyoid fossa. It is bounded anterior by mylohyoid ridge lateral by body of mandible medial by lateral boarder of tongue and posterior by retromylohyoid curtain.

RETROMYLOHYOID CURTAIN

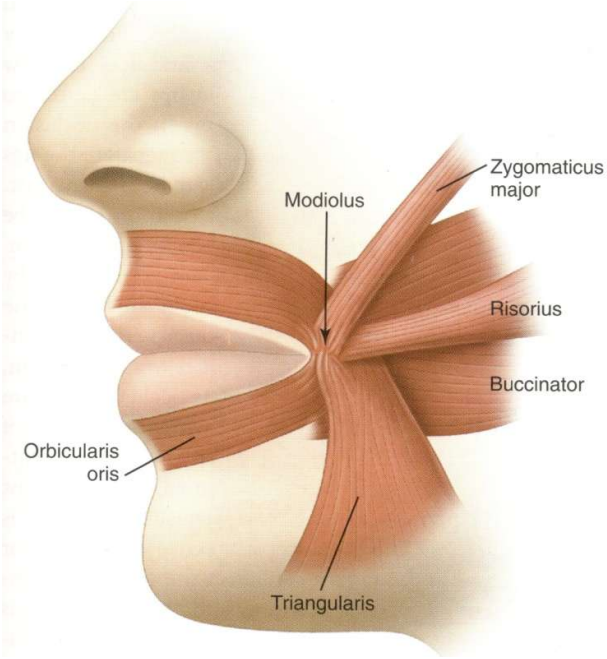
It is a soft tissue curtain separates the oral cavity from the pharynx. It is made of superior constrictor of pharynx from above, palatoglossal from medial and pterygo-mandibular raphe laterally. It gives a c- shaped circle to the disto-lingual end of the lower denture.


RETROMOLAR PAD
SUPERIOR PHARYNGEAL CONSTRICTOR M.
NASSETER MUSCLE
PTERYGO-MANDIBULAR RAPHA
PALATO-GLOSSUS M.
RETROMOLAR PAD
BUCCINATOR M.
MODULOUS
ORGICULARIS ORIS M.


Origin of buccinator and superior pharyngeal constrictor muscles
Lingual frenum
Origin of geniohyoid m.
Origin of genioglossus m.
Sub-lingual salivary gland
Mylohyoid m.
Palatoglossus m.

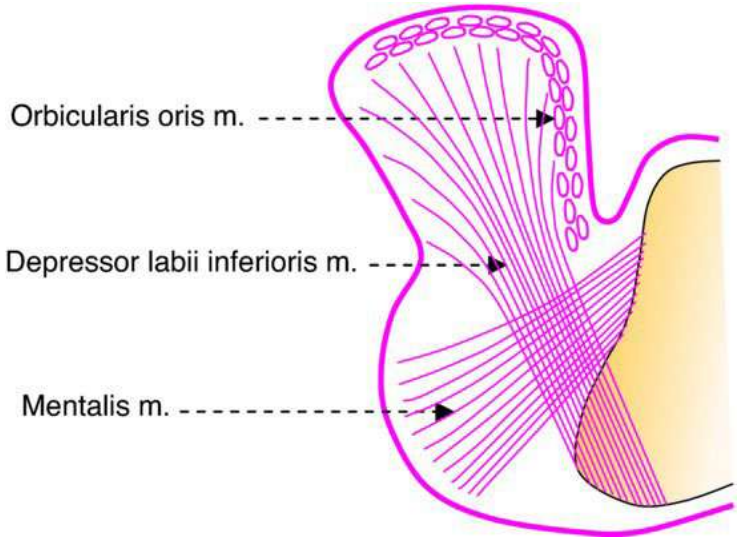
MODULUS

It is a knot like thickening can be feel at near the corner of mouth in facial muscles. It is the combine insertion of the facial muscles. It should not be displaced by denture otherwise it displaces the dentures during contraction.



MENTALIS MUSCLE

It is the muscle of lower lip. It is a strong muscle. If the denture over extends in the labial sulcus mentalis muscles push it backwards and destabilize it.



EXAMINATION OF EDENTULOUS PATIENT

The examination of patient can be divided into
- General Examination
- Extra Oral Examination
- Intra Oral Examination
- Radiographic Examination

GENERAL EXAMINATION

HEALTH
Good Fair Poor

BUILT
Muscular Obese Emaciated

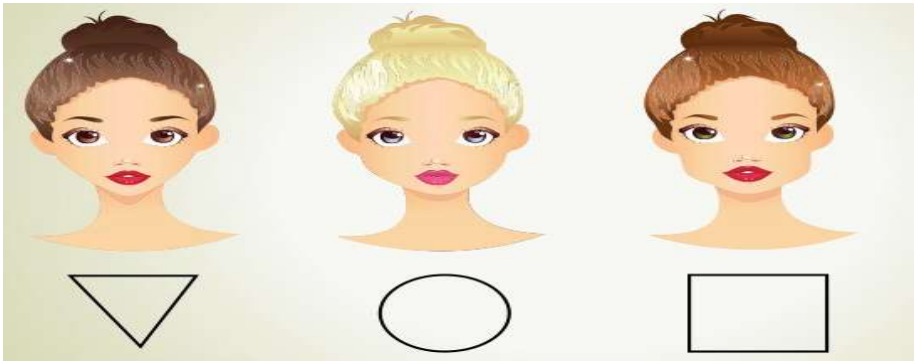
HEIGHT
Tall Medium Short

EXTRA ORAL EXAMINATION

COMPLEXION
Fair Pale Brownish Dark

FACE FORM

The face form of human beings can be divided into three broad groups,
Square, Tapering, Ovoid. The face form can be determined by comparing Bi-temporal, Bi-zygomatic and Bi- angular width of the face. It is observed by standing in front of the patient.



SQUARE FORM
If all three measurements i.e. Bi-temporal, Bi- zygomatic and Bi- angular widths are equal, then the face form is squarish.

TAPERING FORM
If the bi-temporal and bi-zygomatic widths are equal but the bi-angular width is less, than the face form is Tapering. Or bi-angular width is less than bi-temporal and bi-zygomatic widths.

OVOID FORM

If the bi-temporal and bi-angular width are equal but the bi-zygomatic width is greater, than the face form is Ovoid. Or bi-zygomatic width is greater than bi-temporal and bi-angular widths. No human being can be strictly classified into groups. So, there are some secondary characters, i.e. Secondary Form of Face. For example, if the face form of a person is Squarish but the chin is pointed. This gives a tapering look to the face. This second look is the secondary character of the face. So, this face is called a Tapering Squarish face. The secondary character comes first. The secondary character is also of three types, i.e. Squarish, Tapering and Ovoid.

FACIAL PROFILE

It is the anterior posterior shape of the face. The facial profile is observed from the lateral side.

STRAIGHT PROFILE

If the Forehead, Maxilla and Chin are in one plane then the facial profile is straight.

CONVEX PROFILE

If the Forehead and Chin are in one plane but the Maxilla is forward then the facial profile is convex.

CONCAVE PROFILE

If the Forehead and Chin are in one plane but the Maxilla is backward then the facial profile is concave.

Concave Straight Convex

LENGTH OF FACE

Face can be divided normal appearance in three classes

Long Medium Small

Large faces require long teeth and small faces small teeth.

TONE OF FACIAL MUSCLES

The tone of the muscles is the contraction in muscles without any stimulus. It can be checked by asking the patient to blow the mouth and keep the air in. if patient keeps the air in for some time the tone is normal, if keep it for little time the tone is partially loss and if cannot do it then the tone is completely lost.

As tone of muscles decreases it make more difficult to improve the patient's esthetics due to increase facial creases and difficult for patient to control the dentures. The tone also decreases with increasing age and poor health. Muscle exercises are used to increase the muscle tone.

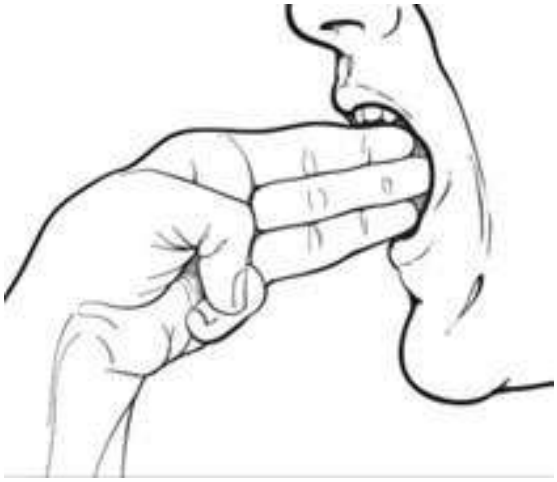
MASTICATORY MUSCLES

It can be checked by placing the two fingers on patients ridges and ask to lightly press them and can be classifying on the amount of pressure felt. The patients with strong muscles applied greater forces on dentures. The muscles power will decrease as the age of edentulism increases.

TMJ (Jaw movements)

In normal opening of edentulous mouth four fingers of hand can be easily inserted vertically in the mouth in edentulous patients (three fingers in dentate patients). Any less then this is restricted opening.

Take a scale ask the patient to wide open the mouth and measure the distance between the upper and lower ridges. This is the maximum opening of mouth. The normal mouth opening is 40-45mm. Mark a line with indelible pencil in the mid line of both arches. Ask the patient to move the mandible on right side now measure the distance between upper and lower lines and noted it. Repeat this on left side. These are the right and left range of movements. 5-7mm is the normal lateral movement of mandible. Any problem of TMJ can restrict the opening of the jaws. TMJ can be examining for any sounds. There are two types of sounds i.e. clicking and crepitation. The clicking can be heard on opening and closing of the mouth and it is due to disc displacement and called internal derangement. The crepitation is continuous sounds which can be heard during full cycle of opening and closing movements. This is due to bony problems as arthritis.



Mouth opening

MICROSTOMIA

RESTRICTED ORAL APERTURE (MICROSTOMIA):-

The normal mouth opening is 65mm. Less than 50mm is consider limited mouth opening or microstomia. This should be differentiated from restricted mouth opening due to TMJ problem in which the oral aperture can be open by operator easily to normal limits. In restricted oral aperture the problem lies in facial muscles. The causes of restricted oral aperture are following.

Burns
Surgery
Radiotherapy
Submucous-fibrosis
Congenital
Scleroderma

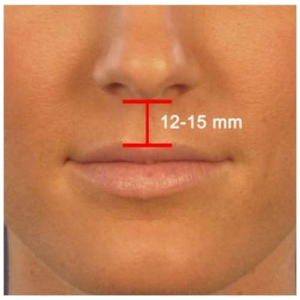
In microsomia patient management depends upon the severity of the problem. In mild cases the lubrication of the trays and use of small trays is required. In mild cases the sectional impressions and sectional dentures can solve the problem. In severe cases the surgery in the only option.

LIP THICKNESS

The thickness is the internal character of the lip. The thin lips need careful support from the dentures i.e., any slight over support can change the facial appearance. The thick lips can accommodate any over or under support mistakes.

LIP LENGTH

The lip length can use for selection of upper anterior teeth. The patients with small lip required small teeth and long lips required long teeth. 12-15mm is average length, less is small and more is mark large. It effects the size of anterior teeth



INTRA-ORAL EXAMINATION

MUCOSA

COLOR

Normal healthy mucosa is of pink color and dark color is also normal. The pail whitish color indicates unhealthy, poor, thin and non-keratinized mucosa. The reddish mucosa shows inflammation.

THICKNESS ON RIDGES

Mucosa provides cushioning effects to the denture. It distributes the load on the underline bone. The normal thickness of mucosa is 2mm. The increase thickness of mucosa causes slipping of the denture i.e., it provides poor support and thin mucosa crashed between bone and dentures and cause pain.

Type 1 (2mm)
Type 2 (<2mm)
Type 3 (>2mm)

The thickness of the mucosa on the alveolar ridges can be measured by the following method. Take a ball burnisher of 2mm thickness. Compress the mucosa on the alveolar ridge by this burnisher.

If half of the burnisher dips into the mucosa then the mucosa has a thickness of 2mm, i.e. Type 1. It is normal mucosa.

If whole of the burnisher dips into mucosa then it has a thickness of more than 2mm, i.e. Type2. The mucosa is atrophic.

If less than half of the burnisher dips into mucosa then it has a thickness of less than 2mm, i.e. Type 3. The mucosa is hypertrophic or hyperplastic.

CAUSES OF UNHEALTHY MUCOSA

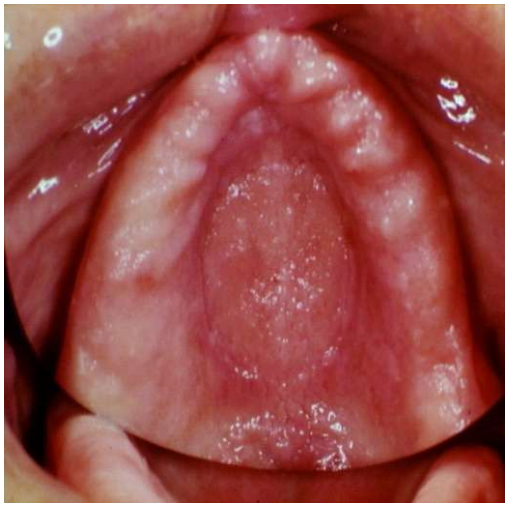
- Diabetes
- Low caloric intake
- Medication
- Low fibrous soft diet
- Smoking
- Alcohol abuse
- Xerostomia

OTHER PATHOLOGIES

SUCTION DISC HYPERPLASIA

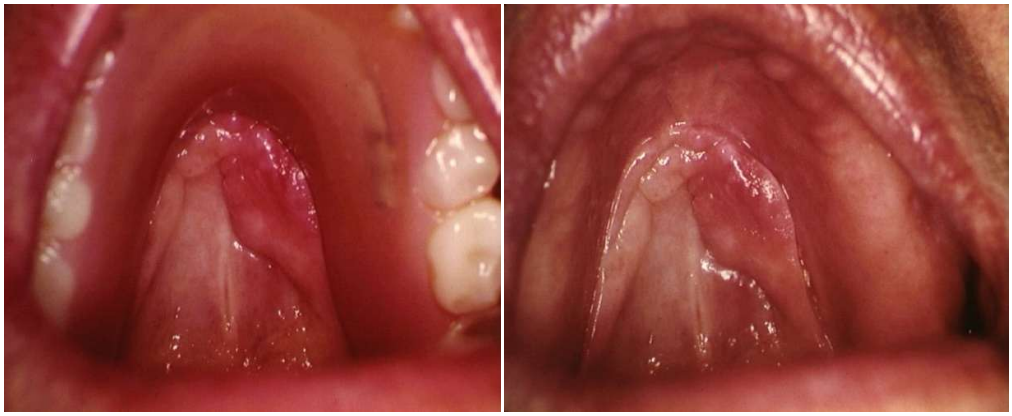
Suction disc is used once for retention of dentures. Its use causes the hyperplasia of tissue and pro-long use may perforate the hard palate. It appears a rounded growth of soft tissues in the center of hard palate.

Suction Disc



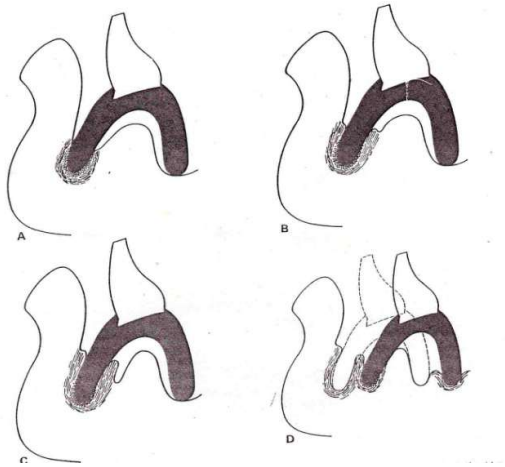
Suction Disc Hyperplasia

EPULIS FISSRATUM

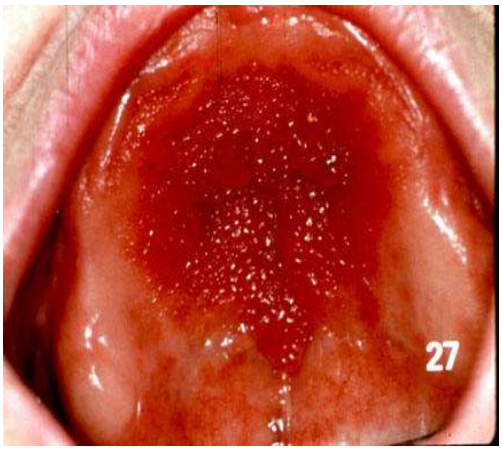


The continuous unsupervised use of complete dentures causes bone resorption. This bone resorption reduces the height of ridges so the depth of sulcus also reduces and increases the length of denture flanges. If denture wearing continues without relining the flanges become over extended. These over extended flanges cause trauma to the tissues in sulcus depth. The healing took place. Then again trauma develop and healing occurs by fibroses. The loose

denture also frequently changes its position horizontally and multiple traumas and fibroses develop at the same side. This appears soft tissue hyperplasia with multiple fissures. So, it is called epulis fissuratum. It is a slow and painless process so that nu noticed by patient.



Development of Epulis Fissuratum



Papillary Hyperplasia

PAPILLARY HYPERPLASIA

It develops in the center of hard palate due to loosen old dentures. The loose old denture, due to bone resorption, moves and irritates the soft tissues on hard palate. This abrasion damages the tissues and reactionary hyperplasia develops. This looks like multiple projections like papilla so called papillary hyperplasia.

BORDER TISSUE ATTACHMENTS

The proximity of the muscle attachment to the ridge crest increases or decreases the length of the denture flange. Consequently, the more distant the muscle attachment is from the ridge crest the more favorable is the depth of the sulcus and better support for dentures. It is the height of the residual ridges. As the bone resorption increases it brings the soft tissues attachment near to the crest of the ridge and reduces the sulcus depth. Border tissue attachment constitutes the tissues referred to as the mucobuccal and mucolingual reflections and comprises the superficial mucosa and the deeper parts formed by muscle fibers.

It can be checked by pulling the cheeks downward in maxilla and upward in mandible and observing the depth of the sulcus.

The degree of movement is governed by the position of muscle attachment which is classified as

VERY FAR FROM THE RIDGE CREST

Most favorable: the attachments are about 15 mm. distant from the ridge crest.

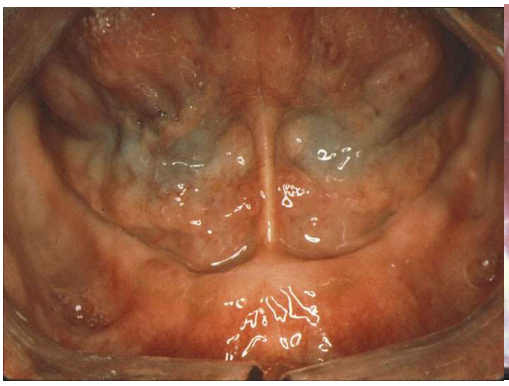
Very far from the ridge crest

MODERATE DISTANCE FROM THE RIDGE CREST

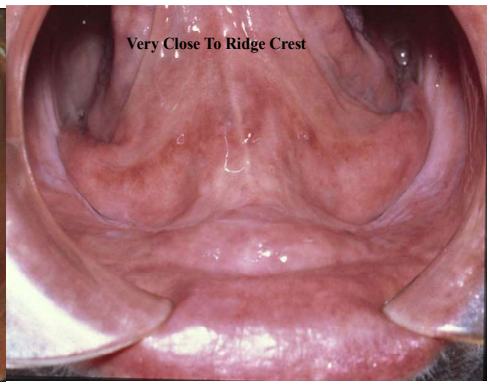
Normal: the attachments are about 14-10 mm. distant from the ridge crest.

VERY CLOSE TO THE RIDGE CREST

Unfavorable: the attachments are about less than 10 mm. distant from the ridge crest.



Moderate distance from the ridge crest



Very close to the ridge crest

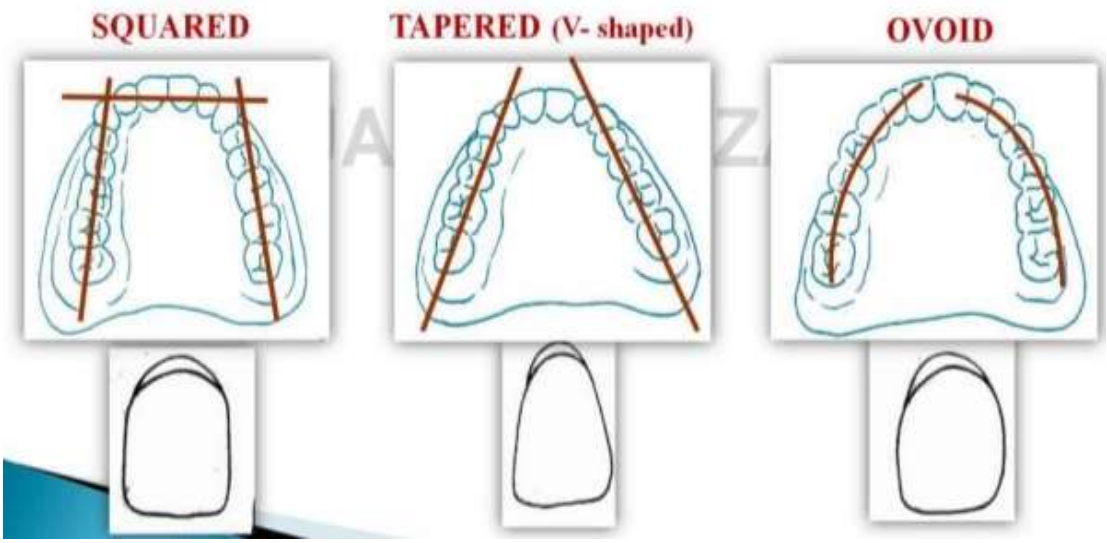
If the frenum are attached too close to the crest of the ridge, surgical intervention may be indicated.

SIZE OF DENTURE BEARING AREA

Size of the denture bearing area can be determined by the help of stock impression trays.

ARCH SHAPE

This classification is based on the outline form of the ridges in the horizontal plane as it suggests a square, tapering or oval form. The angle of the canines (canine eminences in edentulous) with the incisive papilla is most common landmarks to use for arch shape. The distance between canines or canine eminences in the horizontal plane and distance between the maxillary tuberosities is also use for arch classification.



SQUARE ARCH

If the angle between the incisive papilla and canine eminencies is near 90 degrees i.e., near straight line, the arch is squish. If the inter canine distance and inter tuberosity distance is same the arch is also called square. The square type has a relatively flat curve of the anterior segment with the right and left posterior segments running backward parallel with each other from their junction with the anterior segment. The canine eminences are nearly at right angles from the incisive papilla.

TAPERING

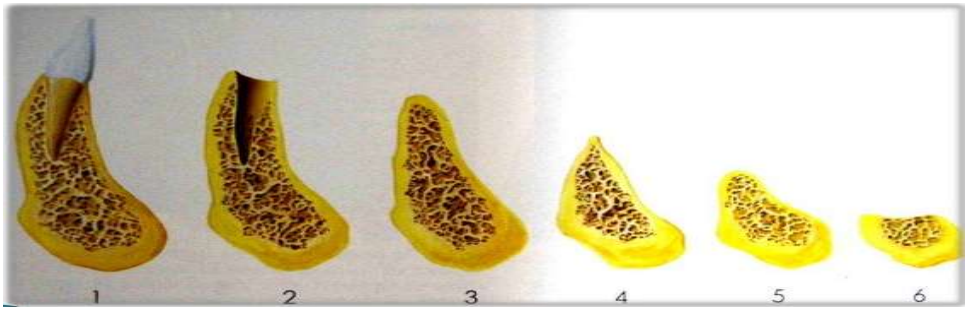
The tapering type consists of flaring and diverging segments suggesting a triangle. A triangle formed when angle between canine eminences on both side and incisive papilla is near 45^0. In The posterior segment when inter canine distance is less than inter tuberosity distance arch is called tapering.

OVOID

The ovoid type is rounded in the anterior and posterior segments. When the angle between canines and incisive papilla is between 90 and 45 degree the arch is ovoid. In posterior segment when inter canine distance is greater than inter tuberosity distance arch is called ovoid.
The square arch is more favorable for retention and stability. The ovoid is slightly less favorable and the tapering arch is the least favorable.

Pure types are met only occasionally. It is quite common for the right side to differ from the left side; also, one side will vary in its form from that of the opposite side. These variations between the anterior and posterior segments and between the right and left sides give the cross-bite relation and the variation between the upper and lower forms may result in the same type of variation of the retro and pro gnathic relations. Thus, a combination of arch forms may exist in one or both arches. Arch form may with more certainty be classified after casts have been obtained.

RESIDUAL RIDGES
FORM
The form of the residual ridges depends on the level of bone resorption. As the bone resorption progresses the ridge form changes to other form. This is the classification of the shape of the ridges according to the progress of bone resorption. It should be noted in all segments of the ridges because it may vary in different segment. According to Atwood's classification following shapes can be found.



PRE EXTRACTON

This phase I in Atwood classification

POST EXTRACTION

Immediately after extraction or after few days the bone show incomplete resorption and irregular ridges show the margins of socket. This is the first order of bone resorption.

HIGH WELL ROUNDED

After six weeks the active bone resorption completes and socket heals. The ridges become smooth and regular in shape and well rounded. Due to low bone resorption the ridges are high.

KNIFE EDGE

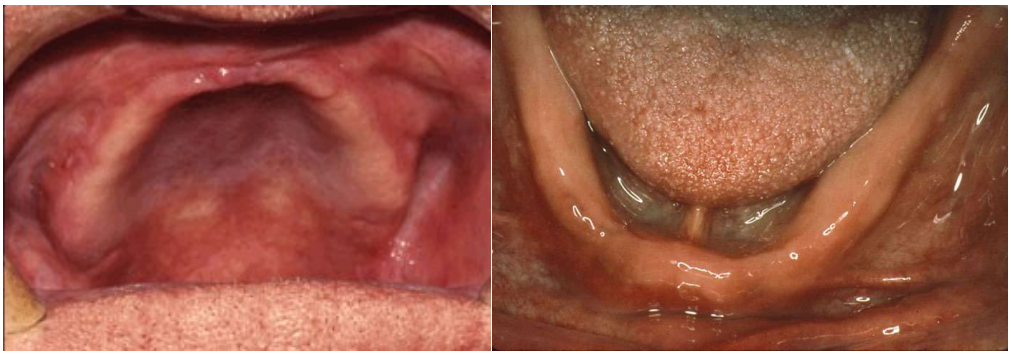
The masticatory load concentrated on the buccal and lingual slopes of the ridges and cause more bone resorption on ridge slops than on the ridge crest. The crest of the ridge becomes very thin. This pattern of bone resorption changes the shape of the ridges from well-rounded to knife edge.

LOW WELL ROUNDED

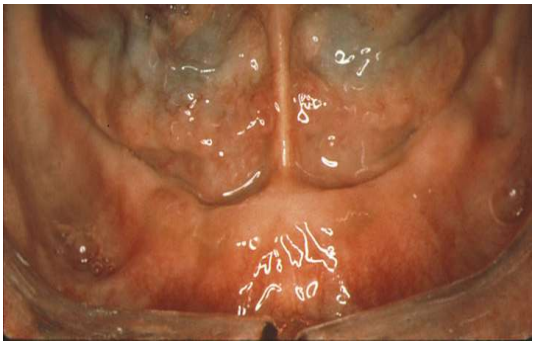
The occlusal load continues the bone resorption. The load on the ridge crest now resorbs the bone and the knife edge crest disappears. The shape now becomes well rounded but the height of the ridge reduces. This is the low well-rounded ridge.

DEPRESSED

The pressure on the low well-rounded ridge concentrates on the crest. This reduces the bone from the crest and changes its shape. The shape now becomes depressed i.e., deep in the center and elevated sides.

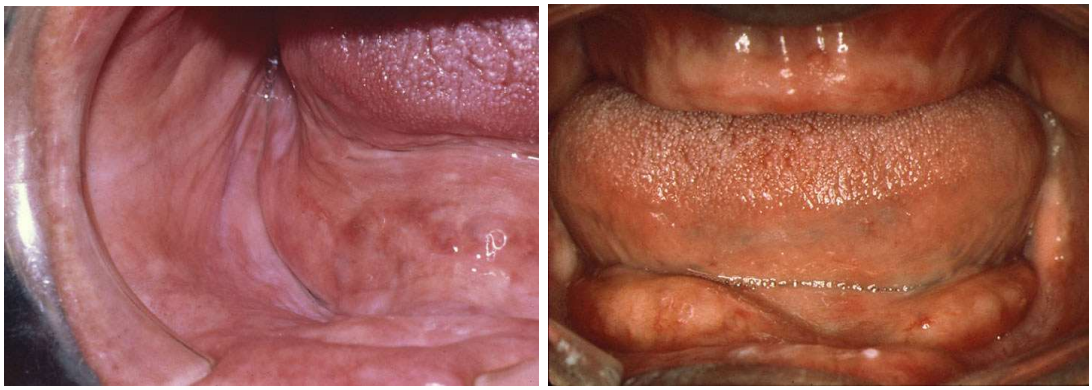


High Well Rounded



Knife edege ridges

low well Rounded



Depressed Ridges

RIDGE RELATIONSHIP

ORTHOGNATHIC

The lower ridge crest is slightly inside of the upper ridge crest, except at the second molar area where it runs outside the uppers. No difficulty is expected in the normal positioning of the teeth for proper leverage, for direction of stress application and for obtaining maximum esthetic qualities. This is the normal jaw relation.

RETRONGNATHIC

The lower arch is smaller than the upper and the lower ridge crest is inside the upper ridge crest considerably more than in the normal. These patients often hold the mandible forward to improve appearances with subsequent TMJ problems. They usually have a great range of jaw movements in function, require careful occlusion and often require a large inter occlusal distance.

PROGNATHIC

The lower arch is larger all around than the upper; the upper ridge crest is inside of the lower ridge crest. When this ridge relationship is restricted to one or both posterior regions or to the anterior region, it is a cross bite relationship. The positioning of teeth may follow an atypical arrangement. Protrusive setup is usually easier to arrange then retrusive setups. They usually function on a hinge (little or no protrusive component) and require a minimum of interocclusal distance.

PSEUDO PROGNATHIC

The pattern of bone resorption is upward and in word in maxilla and down word and out ward in mandible. This pattern makes the maxilla smaller and mandible larger. This creates a prognathic relation of upper and lower casts on the articulator. But in clinical examination the profile of patients show class I relation. This is called Pseudo prognathism and it is due to bone resorption pattern. In any case, do not try to change a retrusive or protrusive case to a normal relationship.

RESIDUAL RIDGE MORPHOLOGY

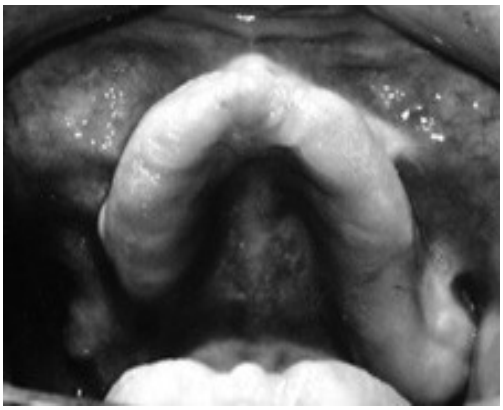
RIDGE SHAPE	RIDGE HEIGHT	TISSUE ATTACHMENTS	PROGNOSIS	MANAGEMENT
High well rounded	More than 21mm from least vertical height	Far away from ridge crest	Very good with conventional prosthodontics	Can be treated by students and house officers.
Knife edge	16-20mm from least vertical height	Moderate distance from ridge crest	Continuation of physical degradation of denture support structures and localize soft tissue factors.	Patient education about reducing the denture wearing hours. Resting and physio therapy of denture supporting tissues. Implant placements options.
Low well rounded	11-15 from least vertical height	Very near to ridge crest	Residual ridge has minimum influence to resist horizontal and vertical movements of the denture base.	Surgical intervention may require for improvement of denture supporting structures as vestibuloplasty, implant therapy. Special impression techniques required, distribution of load on broad areas needs occlusal modification
Depressed	less than 15mm from least vertical height	At the level of the ridge crest	Residual ridge has no influence to resist horizontal and vertical movements of the denture base. Location of muscle attachments also reduces the retention and stability.	Surgical intervention is required but can not possible due to health problems of patients. Consultant level operators can handle these cases by Special conventional prosthodontic techniques.

OTHER FEATURES

HYPERPLASTIC LABIAL SEGMENT OR FLABBY PER MAXILLA

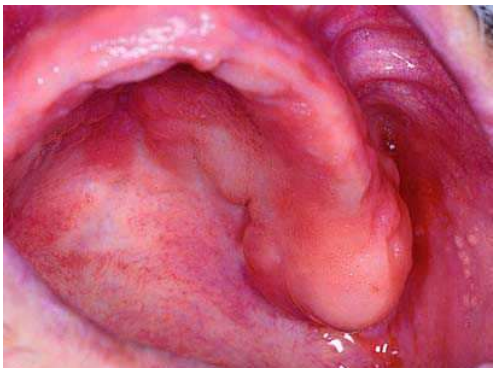
This condition is seen in upper jaw of old denture wearers. This is the displaceable hyperplastic tissues in the anterior maxillary ridge. In situations where a complete upper denture is opposed by natural lower teeth in can be seen. The natural lower teeth applied heavy occlusal loads on the upper denture. Under this abnormal load the bone resorbs. The space created by the bone resorption filled by the fibrous tissues. The anterior maxilla has spongy and weak bone so high level of bone resorption and fibrous tissue can be seen here. Extent of hyperplasia depends upon the number of lower teeth present. The fibrous tissue is movable and is poor foundation for denture support. When this condition is found selective pressure technique for impression is advised. The surgical removal of soft tissue is contraindicated. Because the tissue surgery reduces the length of anterior maxilla which cannot oppose the pressure of upper lip and causes dropping of dentures and instability of dentures.

BULGING LABIAL SEGMENT



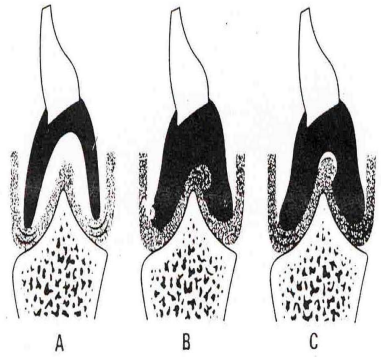
This is the bony growth of the anterior maxilla. It is seen in Angles class II cases. This type of anterior maxilla also has labial bony under cuts. This is most difficult case in reference to esthetics. Prominent anterior maxilla cannot accommodate the labial flange and anterior teeth. Lots of teeth grinding is required. The open face dentures are also indicated in these cases. The surgical reduction of anterior maxilla is recommended in severe cases.

BULGING MAXILLARY TUBEROSITES

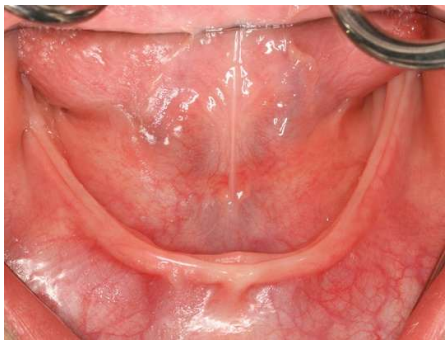


Large tuberosities provide good support and retention; however, they must be viewed with care. Extremely long tuberosities that can interfere with the lower denture should be reduced. Large over hanging tuberosities can be hard due to bone growth and can be fibrous due to soft tissue growth. The bony enlargement can be due to non-replacement of lot opposing teeth in both, same and opposing, arch. Unopposed tuberosities grow till they touch the opposing ridge or teeth. The fibrous growth is seen in combination syndrome patients where upper denture is opposing by natural lower teeth. Both types of tuberosities should be corrected by surgery. The unilateral undercuts can be utilized for denture retention by changing the path of insertion. Deep and bi lateral under cuts should be corrected by surgery.

UNEMPLOYED LOWER RIDGE



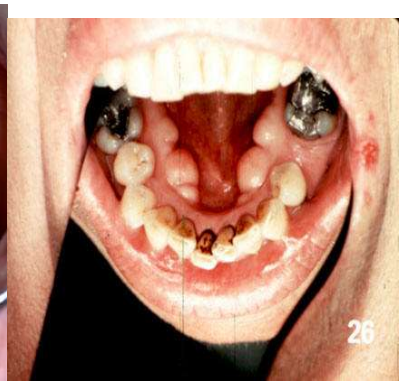
This condition is seen in lower jaw of old denture wearers. It is a band of fibrous tissues on the crest of the lower ridge. This band can be displaced and feels tender on palpation. In old denture wearers this condition develops as the occlusal load reabsorbs the bone fast on the crest of lower ridge than the inclines of the ridge and shifted the load on lateral inclines. The space created by this bone resorption filled by a fibrous band of tissues. This fibrous band is comfortable under old dentures because they have space for it. It cannot tolerate any pressure. In new dentures, if impression taken without care, it causes pain on insertion of the dentures. This is due to the band displaced and pressure transfer on it. In new denture this band should be recorded by selective pressure impression technique. The surgery in contraindicated because the band is very thin and surgery also reduces the attach mucosa from the ridge.



TORUS PALATINUS & TORUS MANDIBULARUS

These are bony enlargements in mid of palate and in lingual side of mandible in pre molar areas. The management of palatine tori is depended on it size and shape. Small diffuse type of tori can be adjusted by selective pressure impression technique and by providing relief in dentures. Medium to large size tori need surgery. All mandible tori reduce the space available for lingual flange and required surgery.

Torus Paltinus



Torus Mandibularus

SHARP MYLOHYOID RIDGE

This can be found in lingual side of mandible in molar region as sharp ridge tender on palpation. This is the attachment side on mylohyoid muscles. With bone resorption the mylohyoid ridge comes near to the crest of ridge and when denture placed on it causes pain. The surgery in indicated in severe cases.

PALATAL REGION

HARD PALATE

The shape of hard palate can be divided into

1. U-Shaped
2. Flat
3. V-Shape

The U- shaped palate has high ridges and large vault. This is seen in newly edentulous patients. It provides good retention and support and most favorable condition.

A flat vault has good vertical support but provides no resistance to lateral shifts. It is seen in old edentulous patients with advance level of bone resorption.

A high (V- shaped) vault resists lateral shifts well, but vertical displacement tends to break the seal in all areas at once. it is seen in Angle's class II patients.

U-Shaped palate

Flat palat

V-Shaped palate

SOFT PALATE RELATION

The relation of soft palate with hard palate can be classified as the angle of drop of soft palate into

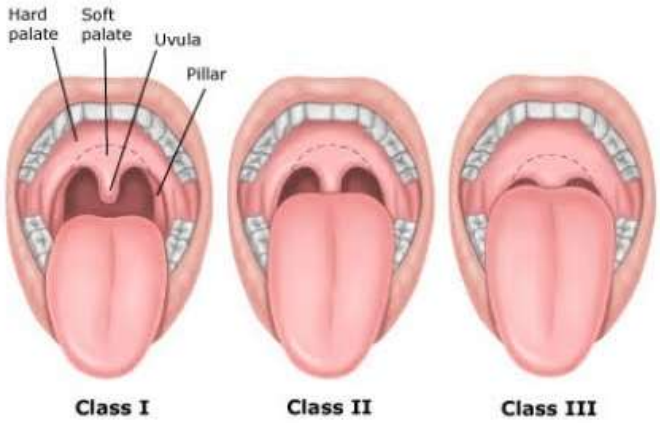
Class1= Horizontal drop
Class II=45^0 drop
Class III=70^0 drop

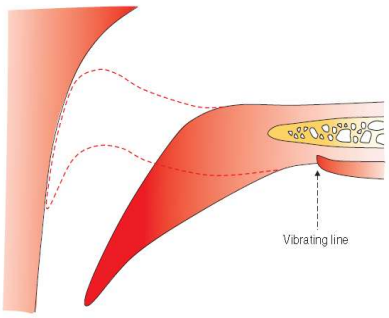
CLASS I -horizontal drop. In this the soft palate has large attachment area with hard palate and well supported. It makes a horizontal angle before in drops. This provides an extra space for denture to extend and larger area for posterior palatal seal (post dam area). It is usually present in cases with a large palatial vault. It is the most favorable configuration.

CLASS II - The junction between the hard and soft palate is more acute than in Class I. It is usually present in cases of moderate length of hard palate. It makes a 45-degree angle. It provides less space for denture extension and posterior palatal seal.

CLASS III- This is a small short, tense and hyper mobile soft palate forming the most acute angle at the junction with the hard palate. The angle approaches a right angle. This is the least favorable configuration. This is mostly seen in narrow palatal vault i.e. V-shaped palate in Angle's class II.

Soft palate relation can be observed by standing in front of the patient and ask the wide opening of the mouth. If the posterior wall of throat is completely visible it is class I, in class II half of the throat is visible and in class III wall is not visible.





POST DAM AREA

This is the area where the posterior palatal seal develops in complete dentures. Post dam area has two boundaries. Posterior boundary is the vibrating line which is an imaginary line starts from one hamular notch to other hamular notch crossing at fovae palatine at the mid line. This is the line from where vibrations start in soft palate. Anterior boundary is on the hard palate and it is the junction of less compressible tissue with more compressible tissue. This tissue can be displaced to get posterior palatal seal. A wider post dam area is more favorable for retention.

Class I-More than 5 mm

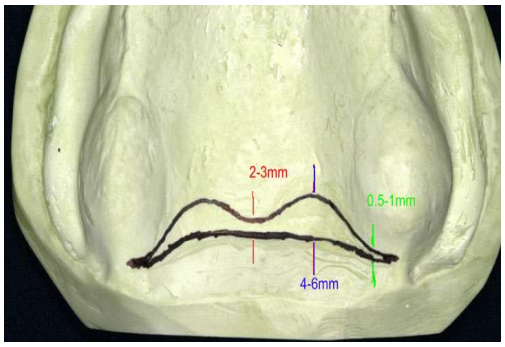
It is large and normal in form with immovable tissue extending posterior from the hard palate for 5-12 mm. It is the most favorable post dam. It is seen with large hard palates and class I, horizontal drop, of the soft palate.

Class II- Between 2-4 mm

It is medium and normal in form having immovable tissue approximately 3-5 mm. posterior to the hard palate. It is seeing in medium sized hard palates with class II soft palate relation i.e. 45-degree drop.

Class III -Less than 2 mm

It is small with little or no immovable tissue posterior to the hard palate. It is least desirable. It is seen in V-shaped hard palates with class III soft palate relation, 90-degree drop, and in Angle's class II patients.



One should test for compressibility of tissue by palpating the post dam area with a blunt instrument such as a T-ball burnisher. The anterior boundary of post dam can also be mark by the color difference of tissues. The less compressible tissues are light in color due to keratinization on hard palate while the less compressible tissues on soft palate are dark in color due to non keratinization. Marked displacement is more favorable for good retention because a deeper posterior palatal seal can be used. Slight displacement (especially with a flat ridge) can present retention problems.

CLASSIFICATION & RELATION OF HARD PALATE / SOFT PALATE /POST DAM

HARD PALATE SHAPE	SOFT PALATE RELATION	POST DAM AREA	PROGNOSIS
U-Shape	Class-I Horizontal drop	More than 5mm	Very good for stability and retention. Very good posterior palatal seal
Flat	Cass II 45^0 drop	2-4 mm	Good for stability and retention. Acceptable posterior palatal seal
V-Shape	Class III 70^0 drop	Less than 2mm	Poor for stability and retention. Poor posterior palatal seal

RETROMYLOHYOID FOSSA

The retro mylohyoid area which constitutes the lower throat form governs the distal and inferior extension of the lingual denture flange. It may be diagnosed by palpating the area while the tongue is alternately relaxed and extended. By this means the relation of the tissue attachment to the ridge crest can be ascertained. Insert the index finger in between the tongue and mandible at distal in retro mylohyoid fossa. Ask the patient to protrude the tongue. Feel the pressure of retro mylohyoid curtain on the finger and judge the depth of the fossa.

CLASS I

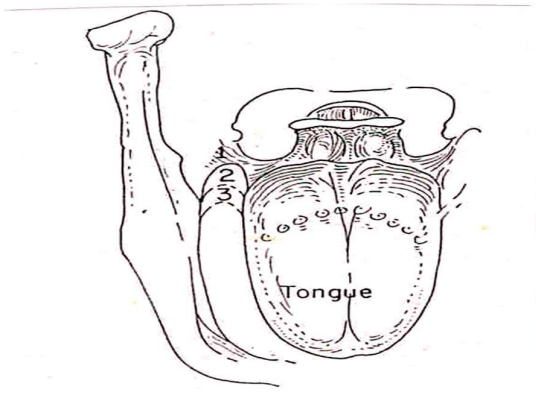
If the minimum pressure feels on the finger, it is of class I i.e., the fossa is deep. This is of most favorable type.

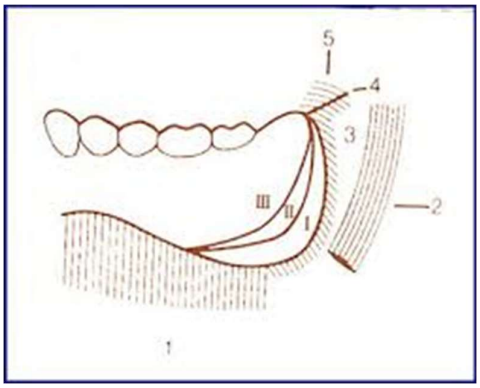
CLASS II

If intermediate pressure feels the fossa is of moderate depth.

CLASS III

If heavy pressure feels the fossa is very shallow and class is III. This type is least favorable.





TONGUE

In normal position, the completely relaxed tongue fills the lower arch, and the apex lightly contacts the lingual surfaces of the lower teeth. This position is usually a result of teeth having been retained for a long period and is most favorable for maintaining the lingual border seal and retention. When teeth have been missing for an extended period and denture replacement has been delayed, the tongue becomes flattened and broadened throughout, thus creating a less favorable condition for denture construction particularly impression making.

CLASS 1

This is long, narrow and tapering tongue. It is favorable in impression making procedures. It is easier to make an impression when the tongue is class I but a seal for lower denture is often inadequate.

CLASS 2

This is small broad and thick tongue. It creates problems in impression making but good for denture retention due to more contact surface area with dentures. It provides an excellent seal for the lower denture.

CLASS 3 (RESTRICTED)

This is the tongue tie case and tongue has limited movements. There are two types of movements in this restricted tongue.

BACKWARD & DOWNWARD

The tongue restriction is backward and downward it allows little favorable condition as there is deep lingual sulcus available distally for denture extension.

BACKWARD & UPWARD

This is most unfavorable condition the upward pull of tongue reduces the lingual sulcus further and compromises the retention and stability severely.

SALIVA

Consistency (viscosity)

Normal Ropy Thin & watery

Quality (quantity)

Normal Excessive Deficient

The quantity present is not easily diagnosed because all foreign bodies in the mouth excite the salivary secretions. Normal amount and viscosity is the most favorable. Thin watery saliva may affect retention. Abundant saliva is common when the denture is first inserted but usually improves with time. Thick ropy saliva complicates impression-making and is annoying to the patient as it clings to the denture. Deficient saliva is usually seen in the geriatric patient and in certain systemic disorders and poses a poor prognosis for retention and comfort.

MENTAL ATTITUDE OF PATIENTS

Proposed by Dr. Miles M. House (House classification)

Patients can be classified as

Philosophical: - Philosophical patients anticipate the need for treatment with complete dentures and are willing to rely on the dentist's advice for diagnosis and treatment.

Exacting: - The exacting patient is concerned about the appearance and efficiency of complete dentures, reluctant to accept the advice of the dentist, and opposed to the extraction of any remaining natural teeth

Indifferent: - These patients show little concern. They are uninterested and have lack of motivation.

Critical: - objecting on everything they also doubt the dentist's ability and even try to direct them regarding the treatment procedure.

Skeptical: - emotionally unstable, excitable, excessively apprehensive, hypertensive hysterical

XEROSTOMIA

Xerostomia is the dryness of mouth due to lack of salivary flow. Saliva has many functions in oral cavity mainly protection of the oral tissues by lubrication. The saliva is also providing retention to the dentures by cohesion and adhesion. It also prevents the sticking of tissues with dentures which cause tearing of tissues.
Xerostomia can be due to destruction of the salivary glands or due to depression of the gland's functions. The destructive type cannot be restored while depression of function can be restoring by removing the cause or stimulating the glands functions.
The control of salivary secretions has three centers. One is cephalic control which can be disturbed by any mental disorder such as depression. The second centre is oral. Any problem in oral cavity can increase or decrease the salivary flow as new dentures or ulcers can increase the flow. The third center is gastric, as gastric irritation or ulcers can increase the flow of saliva.

ETIOLOGY OF XEROSTOMIA

- Medication
- Diabetes
- Depression
- Alcoholism
- Menopause
- Vitamin deficiency (A&B)
- Autoimmune disease (Sjogren's syndrome)
- Therapeutic radiation

The radiation to maxillofacial region and autoimmune diseases leads to the destruction of the salivary gland tissues and fibroses of the glands. It cannot be regenerated. The all other factors depress the glands functions. It can be restored by finding the cause and treating the cause. The glands can be stimulated to function by oral sensations as licking sour things.
In prosthodontic patient with xerostomia causes severe problem of retention and tissue trauma.

MANAGEMENT

The identification of cause and its treatment is the main management. In depression of salivary function as due to medications, smoking and depression, soar food and chewing gum can stimulates the salivary glands. In permanent loss of salivary function, as in autoimmune disease and radiotherapy, the artificial saliva is recommended in edentulous patients. The frequent sipping of milk is also recommended. Few designs of dentures are also recommended with artificial saliva reservoirs.

BURNING MOUTH SYNDROME

This is characterized by a burning sensation in oral cavity. In these patients usually mucosa appears healthy. Most of patients are above 50 years and females and with complete dentures. In post-menopausal women burning of tongue and supporting tissues of dentures are common complains.

SYMPTOMS

- Burning sensation
- Healthy mucosa
- Aggravating during day
- Feeling of dry mouth
- Altered taste

AGGRAVATING FACTORS

- Mental stress
- Fatigue
- Hot food

RELIVING FACTORS

- Sleep
- Eating
- Distraction

LOCAL FACTORS

- Mechanical irritation(dentures)
- Allergy
- Infection
- Para functions
- Myofascial pain

SYSTEMIC FACTORS

- Vitamin deficiency
- Iron deficiency anemia
- Xerostomia
- Menopause
- Diabetes
- Medication

PSYCHOGENIC FACTORS

- Depression
- Anxiety Psychosocial stressors

Management of burning mouth syndrome depends on identification of cause and its treatment by appropriate consultant. Denture cause can be identified by discontinue the denture wearing.

DENTURE STOMATITIS (CANDIDACIES)

It is also called denture induced stomatitis, denture stomatitis, denture sore mouth, inflammatory papillary hyperplasia, chronic atrophic candidiasis.

CLASSIFICATION

According to Newton's classification

CLASS I

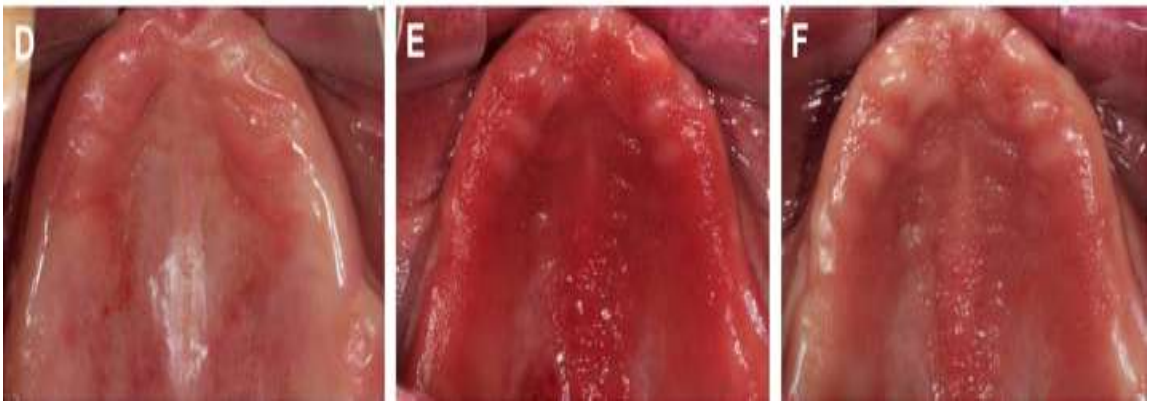
Pinpoint hyperemia. It is localized simple inflammation. It is first stage of denture stomatitis and due to the starting of trauma from denture.

CLASS II

Diffuse erythema involved entire denture bearing area. It is due to continuous wearing of dentures.

CLASS III

Papillary hyperplasia, it is the growth of the inflammatory tissues with Candida infection involving the centre of hard palate and even ridges.



ETIOLOGY

SYSTEMIC FACTORS

Old age
Debilitating disease (Diabetes)
Nutritional deficiencies (iron, B12)
Corticosteroid (local & systemic)
Radiation (Head & Neck)
Oral epithelial dysplasia
Immunodeficiency

LOCAL FACTORS

Dentures
Broad spectrum antibiotics
Xerostomia
High carbohydrate diet
Smoking

MANAGEMENT

It depends on the etiological factors. First step in this is to discontinue the denture use.

DIABETIC EDENTULOUS PATIENT

Problems for complete dentures

Diabetic atherosclerosis and Peripheral neuropathy

It reduces the blood flow in oral mucosa and reduces pain sensations which both delay the healing of any injury.

Always manipulate soft tissues gently. Check any sharp part in special tray and denture bases which may injure the tissue. In case of any injury to tissue refer patient to physician.

Electrolyte imbalance

Electrolyte imbalance at morning increases the size of denture bearing area and with progress of day it reduces and shrinks the denture bearing area. Dentures made on impression taken at morning become loose at evening and impressions taken at evening become tight at morning. It is recommended to fix the appointment at mid day time for all steps of denture fabrication.

Fast bone resorption

It is due to the low blood flow due to atherosclerosis of oral mucosa.

To reduce the bone resorption following steps are recommended to reduce the masticatory load on bone supporting dentures.

- Broad area coverage of denture base area.
- Decrease number of dental units i.e., reducing size of occlusal table
- Decrease bucco lingual width of teeth i.e., reducing the width of occlusal table
- Improved tooth form by using cusped teeth i.e., applying cutting forces rather than crushing forces.
- Providing balance occlusion. Lingualized occlusion
- Centralization of occlusal contacts i.e., creating vertical forces.
- Adequate tongue space i.e., avoiding continuous tongue forces.
- Adequate inter occlusal space i.e., avoiding continuous occlusal forces.
- No use of dentures during sleep i.e., resting the tissues.
- Permanent soft denture bases.

RETENTION AND STABILITY IN COMPLETE DENTURES

It is essential for the success of Prosthodontic treatment that prostheses placed in the mouth should maintain its planned relationship during static and functional movements.

RETENTION

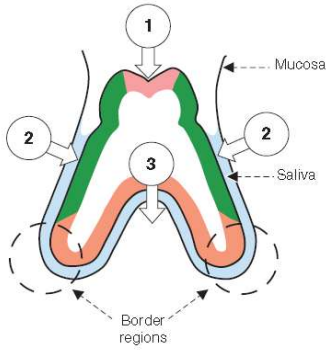
The ability of a denture to resist displacing forces applied apposite its path of insertion or away from its basal seat is called Retention. It is resistance to displacement in static position. Impression surfaces and polished surfaces provide retention.

STABILITY

The other quality is the stability which is the ability of the denture to remain firm, steady and consistent in position when forces are applied on it. It is a functional quality. The extension of flanges and mainly occlusion provides the stability.

SUPPORT

The third quality is the support which is ability to resist vertically applied forces to the dentures in same direction to its path of insertion. It depends on the basal seat tissues.



The all three surfaces of dentures i.e., Impression surface, Polished surface and Occlusal surface all directly or indirectly helps in retention, stability and support of a denture. The impression and polished surfaces are directly engaged in retention of a denture.

There are numbers of factors which are helpful in achieving retention i.e.

1. Physical Factors.
2. Physiological Factors
3. Mechanical Factors
4. Surgical Factors
5. Physiological Factors

1. PHYSICAL FACTORS: -

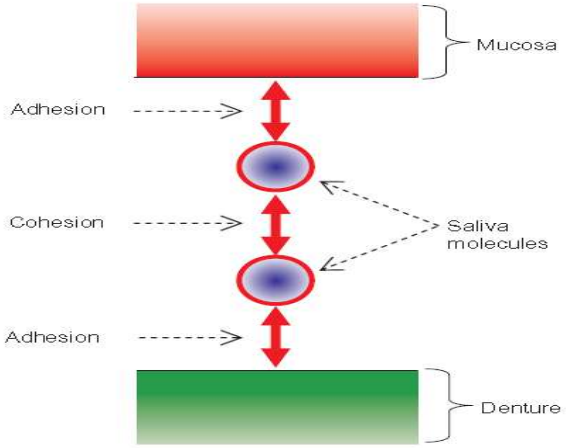
There are the most important factors and act through mainly impression surface and secondly polished surface of dentures.

Physical factors are the physical properties of acrylic/metal base of denture, saliva and mucosa. The intermolecular forces of these materials give rise different physical properties which provide retention to denture. These properties are

Cohesion
Adhesion
Surface Tension
Wet ability
Viscosity
Contact angle

COHESION: -

The cohesion is the physical forces of attraction (intermolecular) between similar molecules.



ADHESION: -

When two substances are bought intro intimate contact with each other, the molecules of one substance adhere to or attracted to molecules of another. This force is called adhesion i.e. physical forces of attraction between dissimilar molecules.

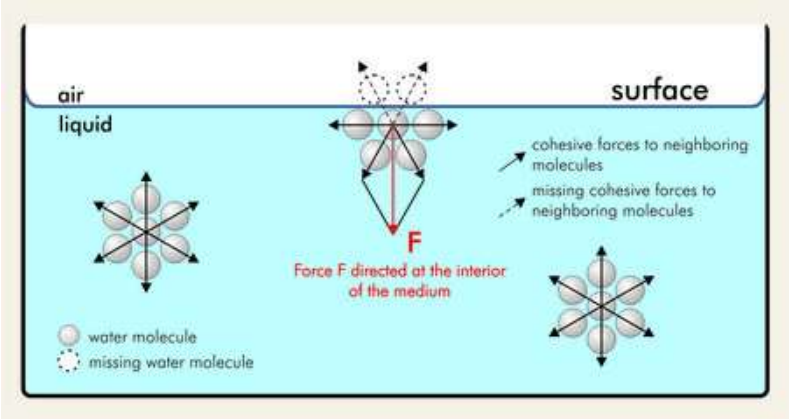
Adhesive are very strong forces. If the dentures adhere directly to the mucosa, it can tear the mucosa on removal of dentures. Nature provides saliva for the protection of oral mucosa. The saliva comes between the denture and mucosa and retains the dentures by the help of its cohesive forces which are weaker forces. Adhesion and cohesion increase as the surface area increases. Saliva goes into the pits and notches of the mucosa and increases the surface area and retention.

SURFACE TENSION: -

The energy at the surface of matter is greater than in its interior. Inside the matter all of the atoms are equally attracted to each other. The interatomic distances are equal and the energy is minimal. At the surface the energy is greater because the outermost atoms are not equally attracted in all directions. This imbalance of attraction forces makes the molecules at or near the surface uncomfortable. At the surface molecules attract other molecules to become comfortable. The increase in energy per unit area of surface is referred to as the surface energy or surface tension. This property is well known reason of rusting of metals.

The surface atoms of a solid tent to form bonds to other atoms that comes into close proximity to the surface in order to reduce the surface energy of the solid. This attraction across the interface for molecules to other molecules creates adhesion. Molecules in air may be attracted to the surface and be absorbed by material i.e., phenomenon of rusting.

The surface tension is acting on upper few layers on molecules. So, for good adhesion the surface of the solid should be clean. the adhesion qualities of a solid can be reduced due to surface impurity.



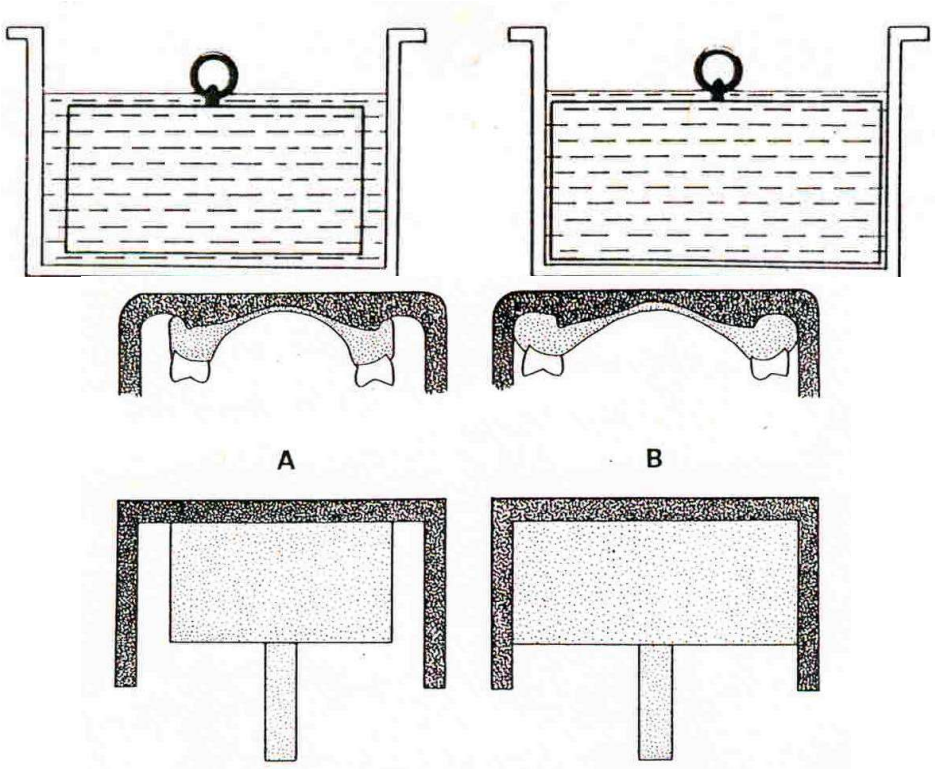
Surface tension

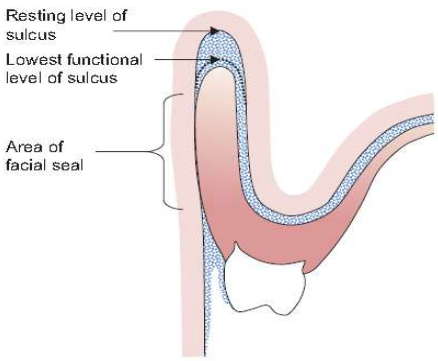
VISCOSITY

Viscosity is the resistance of flow of a fluid resulting from intermolecular forces acting within the liquid.

When a liquid set in motion, the cohesive forces within the liquid act as a form of intermolecular friction to oppose the movement. If a solid block is put in a container near the equal size of it and filled with water the greater force is required to remove the block because the narrow channels between the block and container provide thin layers of water which increases the resistance to the flow of water under the block. The molecules near the walls move slowly because the adhesive forces acting while the central molecules move faster, so a thin film of fluid resist flow more easily than a thicker film. In addition, fluids having high viscosity resist flow more effectively than those of lower viscosity.

A denture in position in mouth covered all over surfaces by a continuous film of saliva. When the denture is subjected to a force tending to displace it, a reduce pressure will result in the saliva film under the denture relative to that in oral cavity. This will cause additional saliva to be drawn under the dentures. A retentive force is generated by a resistance to this flow of saliva, resulting from the viscous properties of saliva and the dimension of channel through which it is flowing. It follows that the narrower the channel and greater the viscosity of saliva the more effective should be the retention.





The addition of saliva beneath the denture results in loss of the retention, because of resultant increase in distance between denture and mucosa. It is therefore essential that the relationship between the periphery of the denture and the surrounding tissues is such that the closest possible adaptation exists. The close adaptation about the periphery will have the effect of delaying the rate of influx of saliva under denture base.

The walls of buccal channel through which the saliva flows differ from each other. The denture flange is rigid while the soft tissues of the lips and cheeks are movable. If the denture is displaced the pressure within the saliva film drops and mucosa is drawn tightly against the denture surface so that the channel between the two becomes very narrow. This causes a greatly increase resistance to flow of saliva and a corresponding increase in retention.

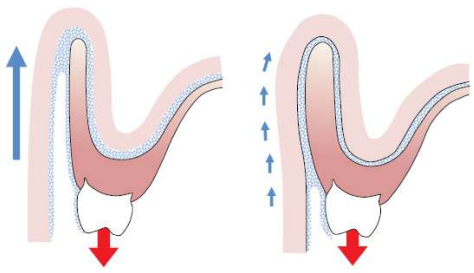
The retentive mechanism resulting from the viscosity of the saliva is vale like action of the soft tissues is best able to resist large displacing forces of short duration. Small forces acting over an extended period of time such as gravity in upper denture result in a much smaller pressure difference between the saliva film and the air. It allows the saliva to be drawn gradually into the space being created beneath the prosthesis. If the effect of the gravity is unopposed a progressive downward movement of the upper denture is likely to occur until all retention is lost and the denture drops. In this situation occlusal forces are important in restoring the denture to its former position. Whenever patient occludes excessive saliva accumulated beneath the denture is squeezed out again and denture retained.

WET ABILITY: -

It is very difficult to force two solid surfaces to adhere. Regardless how smooth their surfaces may appear there are hills and valleys on the surface. When they are placed in opposition, only the hills or high points are in contact. Since these areas usually constitute only a small percentage of the total surface so little adhesion takes place.

One method of overcoming this difficulty is to use a fluid that will flow into these irregularities and this provides contact over a great part of the surface of the solid. For example, when two polished glass plates are placed one on top of the other and are pressed together, they exhibit little tendency to adhere. If a film of water is introduced between them, considerable difficulty is encountered in separating the two plates. The surface energy of the glass is sufficiently great to attract the molecules of water.

To produce adhesion in this manner, the liquid must flow easily over the entire surface and adhere to the solid. This characteristic is referred to as wetting. It the liquid does not wet the surface of the adherent, the adhesion between the liquid and the adherend will be negligible or nonexistent. If there is a true wetting of the surface, adhesion failures cannot occur. Failure in such cases usually occurs cohesively

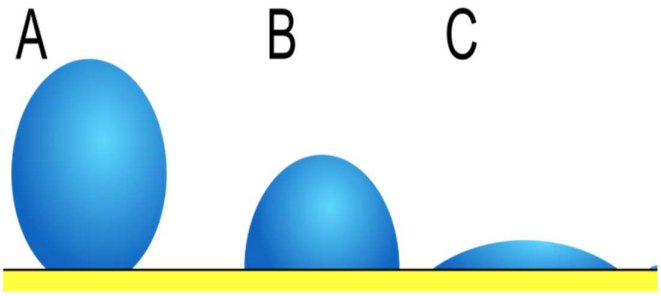


in the solid or in the adhesive itself, not in the interface where the solid and adhesive are in contact.

The ability of an adhesive is depending on cleanliness of the surface. A film of oil only one molecule thick on the surface of the solid may lower the surface energy. The surface energy of some substances is so low that few, if any liquids will wet their surfaces. As resins exhibited low surface energy than metals. The wet ability depends upon the surface tension of the solid and viscosity of liquid. High surface tension attracts the liquid more strongly and spready all over its surface. A high viscosity liquid needs greater forces to
spread over surface. For good retention high surface tension solid and low viscosity liquid is required.

CONTACT ANGLE: -

The extent to which an adhesive will wet the surface of an adherent may be determined by measuring the contact angle between the adhesive and adherent.



The contact angle is formed by the adhesive with the solid surface at their interface. If the surface tension is greater than the cohesive forces of liquid then adhesive, liquid will be speared completely over the surface of the solid and no angle will be formed. The forces of adhesion are stronger than the cohesive forces hold the molecules of the liquid together. If the cohesive forces of adhesive are stronger (as of honey) then the surface tension, then the liquid farms an angle with the adherent as stands on the surface and reduces the wet ability.

Since the tendency for the liquid to spread increases as the contact angle decreases, the contact angle is useful measure of wettability.

The smaller the contact angle, the better able is the adhesive to fill in irregularities in the surface of the adherent.

Facts about Physical forces of retention

- Adhesive forces are stronger than cohesive forces
- Surface tension acts only few layers of molecules
- Adhesion increases as surface area increases
- Adhesion increases as contact angle decreases

To get good retention record the maximum possible denture bearing area. Wash impression records the fine details of tissue and increases the surface area and adhesion.

Reduces the saliva film i.e. contact angle increases the adhesion.

Reducing the saliva flow channels by increasing the thickness of periphery increases the retention.

Keep the impression surface of denture clean for good surface tension.

ATMOSPHERIC PRESSURE

When a displacing force is applied on the dentures its base lost contact with the basal seat area. The checks make a close contact with the denture and prevent the ingress of air. This creates a vacuum or a negative pressure under the dentures. Due to this the higher atmospheric pressure outside pushes the denture towards the basal tissues and keep the dentures at place. The

atmospheric pressure is an emergency retentive force and active only when sudden displacing force is applied. A negative pressure cannot be generated under the dentures continuously which stimulate the soft tissue growth and bone resorption.

PHYSIOLOGICAL RETENTION

Physiological retention can be achieved by the normal physiology of muscles around dentures.

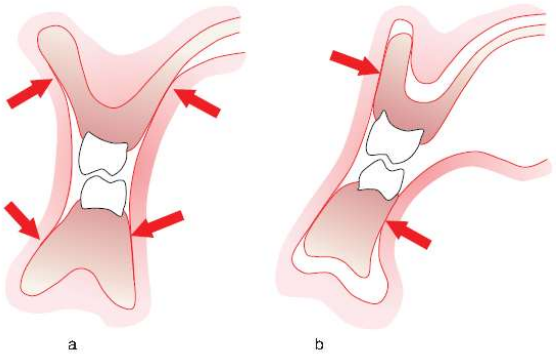
Acquired Muscular Control

A. Buccinators Muscle Control

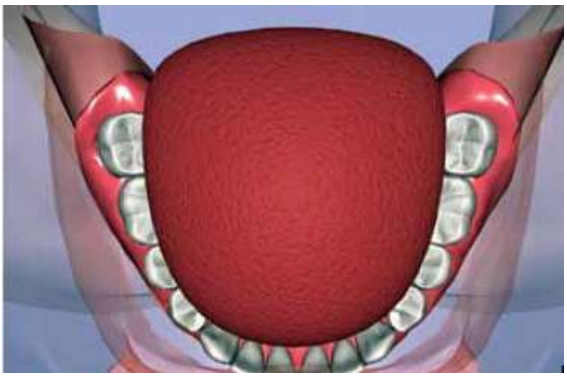
B. Acquired Tongue Control

The muscles of the checks and tongue can be utilized to retain the dentures by proper shaping of the denture flanges.

The contractions of the buccinators are inward. If the denture flanges face the upward and out ward direction in maxilla and downward and outward in mandible then the contraction of buccinators push the dentures toward basal seats and keep them in place. The straight flanges provide a slipping surface for muscles which reduces the retention. On lingual side the direction of flange should be down ward and inward so the tongue functions over the flanges. The occlusal plane should be at the level of lingual cusps of lower teeth so that the lateral boarder of the tongue rest on lingual cusps of lower posterior teeth.



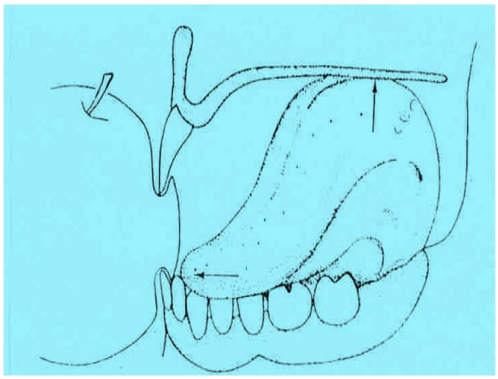
Shapes of flanges



Occlusal plane level

ACQUIRED TONGUE CONTROL

The patient can be instructed to train the tongue in such that when incise the food the tip of tongue should press the anterior lingual flange of lower denture downward and dorsum of tongue push the upper denture upward.



MECHANICAL MEANS OF RETENTION

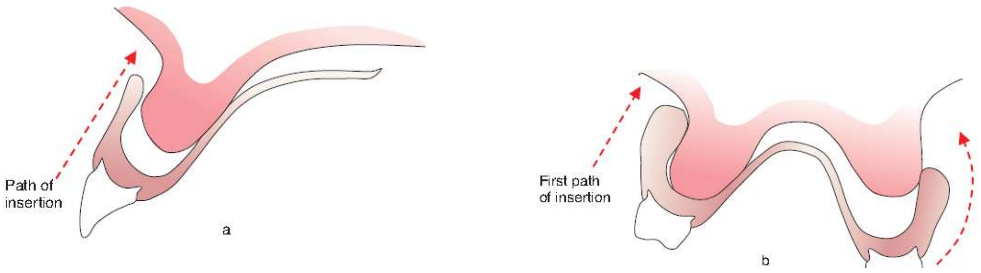
Undercut Areas

Mechanical Devices

- Suction Discs
- Suction Valves
- Suction Chambers
- Springs
- Magnets

UNDERCUT AREAS

Unilateral undercuts of moderate depth can be used for retention by changing the path of insertion of dentures as in anterior maxilla and maxillary tuberocity areas.

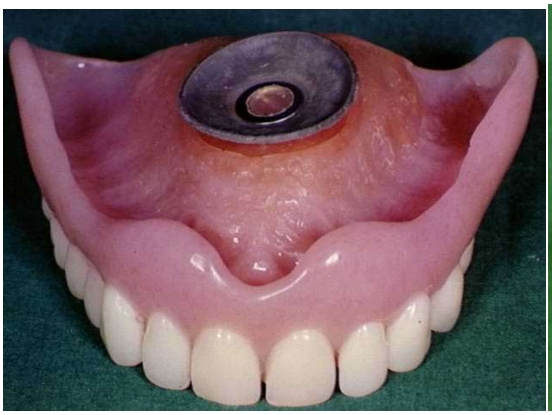


MECHANICAL DEVICES

The different mechanical devices are proposed for retention as suction valves, suction discs and suction chambers. These all suppose to create a negative pressure under the dentures and retain them by atmospheric pressure. But with short time the soft tissues grow in these areas and make these devices ineffective.

Springs were also used for retention. The spring continuously applied the forces on the ridges and cause severe bone resorption in a very short period. They are only advised in complete maxillectomy patients.

The use of magnets was also purpose but have no clinical evidence of success.



Suction Disc

Springs

SURGICAL MEANS OF RETENTION

Different surgical procedures are used to increase the denture bearing area in compromised patients. Such as Vestibuloplasty, Ridge Augmentation and Implants

PSYCHOLOGICAL MEANS OF RETENTION

The psychological means of retention depends on patient's behavior and willingness to use dentures and internal motivation.

IMPRESSION MAKING OF EDENTULOUS PATIENTS

A complete denture is a prosthesis which has to work in the oral cavity bounded by the muscles and has limited space. The denture must maintain planed position in the oral cavity during function and rest. In order to achieve these objectives a cast of the denture bearing area is required which accurately record the tissue morphology and functional positions of the muscles attached around the denture boarders. To make a cast required an accurate impression of the denture bearing area. This impression and cast are used for the fabrication of the base plate of denture. This base plate is not only carrying the teeth but also transfer the occlusal loads to the underlying bone.

An impression is a record of the negative form of the tissues of the oral cavity that make up the basal seat of the denture. It is used to make a CAST - a positive replica. The objectives of the impression are to provide

Retention
Stability
Support
Esthetics
Maintenance and Prevention of the health

RETENTION

The quality of prosthesis to resists the vertical forces of dislodgment opposite its path of insertion. It resists gravity, sticky foods, opening and closing jaws. It is the means by which dentures are held in mouth.

STABILITY

It is the quality of the denture to be firm, steady and constant in position when forces are applied to it. It especially provides resistance against horizontal rotating movement. It depends on the size and form of basal seat, quality of final impression, form of polished surfaces and location and arrangement of artificial teeth.

SUPPORT

It is the resistance to vertical components of mastication and occlusal direction towards the basal seat. It depends on the quality of the basal seat tissues.

IMPRESSION THEORIES

In order to transfer the load to the tissue by the dentures three theories are found in old literature of making impressions

MUCOSTATIC IMPRESSION THEORY: -

Mucostatic theory is based on Pascal's which states that "If a force is applied on a confined liquid, it distributes equally all over the surface."
Human body is 75% liquid and the liquid is confined in cells. So, when a force is applied by the denture on the under lined tissues they act like a confined liquid and distributes this force equally all over the denture bearing area.
According to this theory no broad covering of arch tissues is required to distribute load because pressure anywhere on arch tissue will automatically be distributed on all over the surface.
According to this theory the means of retention are only cohesive and adhesive forces so no peripheral seal and denture flanges are required for these types of dentures.
This theory claims that impression of tissue in resting condition prevents them from undesirable forces all over the day and the keep the tissue healthy and prevents undesirable bone resorption. To achieve this, it is required to make an impression of the arch without any pressure exerting on it i.e. the impression in static or resting position of the soft tissues. Because any pressure on the tissues during impression transfer on whole arch and whole day as long as denture wears. This pressure damages the tissues and compromised the health.

OBJECTIONS ON MUCOSTATIC THEORY: -

1. The physical law meant for mechanics cannot be applied on a dynamic biological environment.
2. The content of fluid can easily be changed from intracellular to extra cellular so the mucosa cannot behave as a confined liquid but it behaves like a semisolid.
3. Even a single touch can displace the mucosa so the "Mucostatic" concept is not practicable. The minimum pressure technique is more appropriate.
4. Fulcrum action that is rocking of denture occurs due to different thickness and compressibility of tissues. During mastication thick tissues compress more and thin tissues less making the bone under thin tissues a fulcrum.

CLINICAL APPLICATION: -
Clinically it is observed that the dentures fabricated on Mucostatic impressions are more retentive and less stable.
The Monostatic impressions are advised in situations where pressure cannot be placed on soft tissues due to their health, as in diabetic patient, patients with thin mucosa and in patient received radio therapy of maxillofacial regions.

REQUIREMENTS

IMPRESSION TRAY
To make mucostatic impressions a spaced impression tray is required. Before fabrication of impression tray a spacer is placed on the model. Spacer is a single sheet of base plate wax applied evenly on the model except on the sulcus depth and on post dam area these areas need

close peripheral seal and are non-stress bearing areas. On this spacer a special tray is fabricated by self-cure acrylic. The spacer should remain in the tray until the periphery has been taken and removed before the wash impression with Zoe paste. It is better to make hole in the impression tray before wash impression after removing spacer in the area covered by spacer. No pressure should be applied during wash impression on the tray.

IMPRESSION MATERIAL

The selective pressure impression can be taken with the help of impression materials. The impression plaster is a fully mucostatic impression material even in a close fitted tray. Zoe and alginate are mucostatic in a spaced tray only.

IMPRESSION TECHNIQUE

The mucostatic impression should be recorded with minimal pressure by the operator. Any extra pressure can displace the tissue and convert the impression as muco compressive one.

MUCO COMPRESSIVE IMPRESSION THEORY: -

This theory states that the body tissue is not a confined environment, the fluid can come and can go easily from the tissue, so the arch tissue cannot behave like a confined liquid.

This theory claims that if the mucosa of the arch is compressed it will exert a back pressure to gain its resting position; this is called “Elastic Recoil of tissue”. This elastic recoil of tissue maintains a close contact with the dentures and helps in retention.

According to this theory the board coverage of area is required to distribute load evenly, by this the load per unit area also decreases and maintain soft tissue health and bone height.

The means of retention in this theory is the atmosphere pressure. This theory states that when the denture is compressed towards the tissue of the arch, the air is expelled out and negative pressure develops under the denture. This negative pressure maintains the denture retention. To achieve this, it is advised to develop a Peripheral seal on denture boarders in the functional height of the sulcus and at posterior palatal area.

According to Muco compressive theory the elastic recoil of the tissue is achieved only when the impression is taken under pressure or in functional form. The load distribution required maximum area coverage within functional limits. The peripheral seal required extension of the denture flanges into the sulcus. The Pressure applied during impression making compress the tissue evenly. So, during chewing load distributed all over the surface area equally and no fulcrum created.

OBJECTIONS ON MUCO COMPRESSIVE THEORY: -

1. The soft tissue cannot be compressed; it can displace or deformed. So, the name muco displacive is more appropriate.
2. To create a negative pressure a cavity is require and there is no cavity under denture. The negative pressure also produces pathological changes in tissue i.e., hyperplasia of soft tissue and demineralization of hard tissues.
3. To achieve atmospheric pressure a stable and tight peripheral seal is required which cannot be produced in a dynamic environment of muscles.

4. Pressure on tissue all around the day also leads some pathological changes in tissue and also bone resorption. This bone resorption brings back the tissue in resting condition and concept of muco compressive lost.

CLINICAL APPLICATION

1. Clinically it is observed that the dentures fabricated on Muco – Compressive impressions are more stable and less retentive.
2. The situations where stability is compromised as in advanced resorption of ridges; Muco-Compressive impressions are advised.
3. When the thickness of the mucosa is not same in all parts of the denture bearing area.

REQUIREMENTS

IMPRESSION TRAY

The muco compressive impression is recorded with a close-fitting special impression tray. In close fitting tray there is no space remain between tissues and tray. It makes by direct applying self-cure acrylic on the cast.

IMPRESSION MATERIAL

The impression compo and impression waxes are muco compressive impression materials they compress tissues even in a spaced tray. The ZnO and alginate compress tissue only in close fitting tray.

IMPRESSION TECHNIQUE

Pressure application is required during wash impression to compress the tissue. Pressure application on a spaced tray can also record the muco compressive impression.
There are two types of muco compressive technique

OPEN MOUTH MUCO COMPRESSIVE TECHNIQUE

In this technique all the impression making procedures performed by the operator with minimum patient involvement.

CLOSE MOUTH MUCO COMPRESSIVE TECHNIQUE

In this technique the patient itself makes the impression. During impression making the patient apply the pressure on the tissue by muscles and mold the periphery by muscular movements. To record this impression, it is required that muscles and jaws of the patient should be supported at its pre-extraction position to perform normal functions. For this on special tray the occlusal rims formed and the vertical height adjusted on patient. After this the Zoe past apply on the periphery in segments and the both impression trays inserted in patient's mouth carry wax rims at patient's vertical height. The patient is provided water and asked to perform the movements. The patient is instructed to sip the water then rinse then spit and in last swallow the saliva. During all these movements the jaws should be closed supported by the rims. It is supposed that these four functions perform all the desired movements of the muscles to their full extent. The advantage of this technique is that the patient's own muscles apply pressure on the tissues which will be the same when patients chew. The muscles itself mold the periphery by their functional requirements. This technique is good for beginners that involvement of inexperience operator minimized. But most of the dentures fabricated on this technique have over extended and sharp

boarders. The patient cooperation is essential for this type of impression making. In very old patient with loss of muscle tone it becomes very difficult to record impression.

SELECTIVE PRESSURE IMPRESSION THEORY: -

This theory states that there are two types of tissue in edentulous arches i.e., stress bearing areas which can tolerate masticatory forces and non-stress bearing areas which cannot tolerate masticatory forces.
According to this theory it is advisable to transfer the load on stress bearing area and relief the load from non-stress bearing area.
This theory also believes that broad area coverage is required for stress distribution as in Muco Compressive theory. The means of retention is same as Muco-static theory i.e., cohesion and adhesion of saliva. This theory also recommends development of peripheral seal only for prevention of excessive saliva flow under the dentures and not for atmosphere pressure as in Muco-Compressive theory.

CLINICAL APPLICATION

Selective pressure impressions are desired in many clinical situations where some localized area is required to prevent from pressure and masticatory load as mucosa over palatine tours, un-employed lower ridges.
The dentures fabricated on selective pressure impressions are equally good in retention and stability.

REQUIREMENTS

IMPRESSION TRAY

A selective pressure impression tray has spacer in some areas and close fitted in other areas. The area which are non-stress bearing as mid palatal suture area rugaes are lined by one sheet base plate wax to protect them from occlusal load. The other areas as residual ridges have no space between tray and tissues.
Selective pressure impressions are more acceptable and better then two. This technique is applicable in almost all cases. It is also helpful in prevention of health of remaining tissues.

IMPRESSION THEORIES

THEORY	DESCRIPTION	TRAY TYPE	IMPRESSION MATERIAL	TECHNIQUE	INDICATIONS
Mucostatic Impression Theory	Record impression under no pressure, based on Pascal's law	Spaced impression tray	Freely flowing like impression plaster, zinc oxide paste, silicon paste	Pressure less technique	Weak thin unhealthy mucosa as in diabetic, radiotherapy and very old patients. Good in retention Compromised in stability
Compressive Impression Theory	Record impression under pressure as during chewing. **Open mouth** when pressure applied by operator **Closed mouth** when pressure applied by patient's own muscles	Closed fitted impression tray	Thick materials like impression compound, silicon putty, zinc oxide paste (in closed fitted tray)	Record impression under pressure either by doctor or by patient	Healthy patients and mucosa, in resorbed ridges where stability is required, Good in stability Compromised in retention
Selective Pressure Impression Theory	Applied pressure on tissues which can bear it and relive tissue from pressure which cannot bear it.	Spaced on some areas and closed fitted on other areas	Freely flowing material as zinc oxide paste and silicon paste	Record impression with normal pressure	Good in all cases, specially applied in cases where mucosa in uneven as in anterior flabby ridges and over tori, bony undercuts & sharp ridges.

OBJECTIVES OF MODERN IMPRESSION MAKING

To record maximum possible area for denture base within the limits of health and function of the supporting and limiting structures.

This required a special impression tray which is made only for individual patient. This tray should extent at the required depth of the sulcus and covered the maximum possible area of the arch. This distributes the load on wider area and decrease the load per unit area. It also minimizes the bone resorption and maintains the health of tissues. The retention is directly proportional to the covered area so also increases the retention of the dentures.

Selective placement of forces by the denture base on supporting tissues

This can be achieved by using a selective pressure impression tray. This required for prevention of bone loss and maintains the health of remaining tissues.

Denture boarders should in harmony with the normal functions of limiting structures around them i.e., muscle balance. A functional molded periphery is required to achieve this.

Maximum and intimate contact of denture base and oral mucosa

This can be achieved by taking wash impression after adjustment of periphery. The physical forces of retention i.e., adhesion and cohesion required a thin film of saliva to between denture and tissues. This intimate contact increases the adhesion and improves the retention. The intimate contact also reduces the movement of denture and prevents the trauma to the tissues of basal seat.

A close peripheral seal

The boarder molding can do this job. It prevents the collection of saliva around the periphery which later can accumulate between the denture and tissue reduces retention. It also provides emergency retentive force by creating a negative pressure below the denture and prevent from dropping i.e., retention, through atmospheric pressure.

Support the lips and cheeks at pre-extraction position (Esthetics).

The proper thickness (2-4mm) of the flanges can support the lips and checks according to the bone resorption. It restores the esthetics. The complete filling of the sulcus also prevents the accumulation of food during mastication in sulcus.

Prevention and maintenances of health

The board area coverage distribute load on wider area and reduces load per unit area and selective placement of load on stress bearing area both prevents and maintain the health of remaining tissues.

SPECIAL IMPRESSION TRAYS

DEFINITION

A Custom Tray or special tray is an individualized tray made from a cast recovered from a primary impression. It is used in making a final impression.

IMPRESSION TRAYS

There are two types of impression trays i.e., the stock trays and special trays. Stock trays are supplied in limited range of shapes and sizes. They are usually made of metal and plastic. The plastic trays are usually disposable. They may be prepared for some particular impression material as perforated trays for alginate impressions. They also have different shapes as rectangular shaped for dentate regions and "U" shaped for edentulous regions of the dental arches. The stock trays are rarely fit accurately to the denture bearing area so that an accurate working cast is produced. Thus, stock trays are generally used to take primary impressions to make a cast on which a special tray can be made. A more accurate impression can be made by the special trays.

All impressions trays should possess the following character.

1. They must be clean and smooth.
2. Rigid, strong and dimensionally stable.
3. They should permit the correct thickness of impression material.
4. The handle should not displace the lip.
5. They should cover the whole area of arch.
6. They should support the lips and cheeks in the pre-extraction position.

The special trays can be classified into three types according to the impression to be taken i.e.

1. Close fitting trays
2. Spaced trays
3. Selective pressure trays

CLOSE FITTING TRAYS:

'The trays are made on the cast which has no space between the cast and tray material. These trays are closely fit in the edentulous mouth. The trays are used to make the muco compressive impressions. In these impressions the compressive form of mucosa is recording as in functional position so that the dentures should be stable during chewing. A very thin film of impression material is required for these trays. These impressions are called "wash impression" and usually ZOE paste is used for impression in these trays.

SPACED TRAYS:

In these trays a space exists between the cast and tray material. This space can be produced by applying one or two thickness of base plate wax on the cast. The wax should cover all dentures bearing area except periphery and post dam area (posterior boarder of upper denture). These trays are required to make mucostatic impressions. In this impression mucosa recorded in its resting form so the denture should be retentive whole day. These trays produce minimal pressure on denture bearing area.

SELECTIVE PRESSURE TRAYS:

In these trays some areas are closely fitted to oral mucosa while other areas have space between tray and tissues. The trays can record impression in different positions of mucosa in one tray. The" close fitting area can record impression in functional form while spaced areas take impression in resting form. In this way masticatory local can be applied on those areas which can tolerate it while other areas of mucosa can be protected from these masticatory loads. These types of impressions called "selective pressure impressions".

Close fitting tray Spaced tray spacer Selective pressure tray

CLINICAL METHOD TO MAKE FINAL IMPRESSION

Materials & Instruments

1. Special Impression Trays

2. Sprite Lamp

3. B.P. Knife (No. 15 Blade)

4. Bowl with hot water (65^{o}C)

5. Bowl with cold water

6. Indelible Pencil

7. Glass Slab

8. Past spatula

9. Low fusing compo (Green Stick)

10. ZoE Impression past

11. Cotton /Gaze

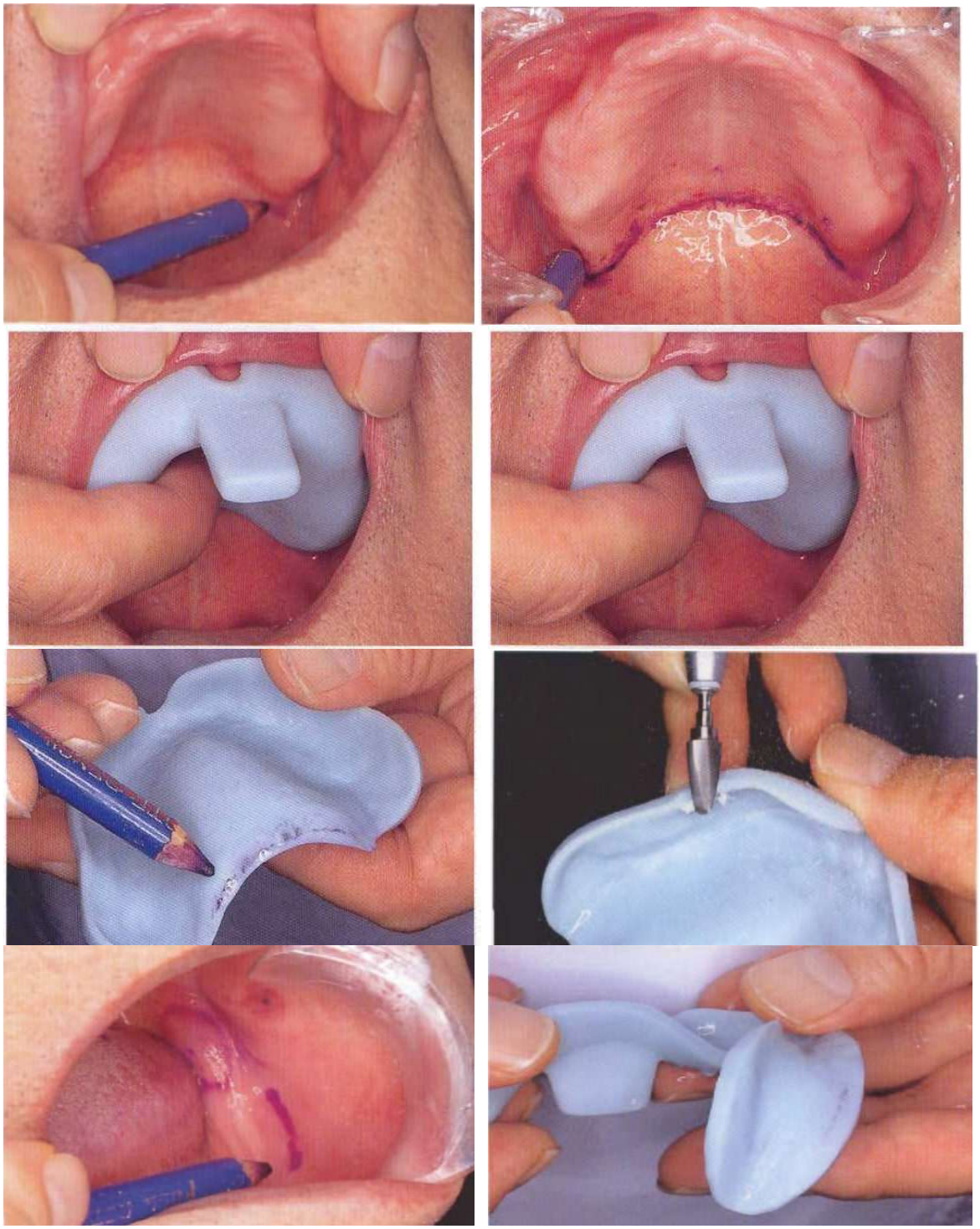
12. Petroleum jelly

13. 2mm ball burnisher

TECHNIQUE

ADJUSTMENT OF SPECIAL TRAY

First check the boarders of the impression tray in the oral cavity. The boarder should be 1-2mm short of functional sulcus depth. Hold the impression tray in contact with the arch tissues and moved the lips and checks down ward in maxilla and upward in mandible. During this movement any displacement of the tray shows the over extension at that particular area. Remove the tray and trim at that area. On all muscular movement tray should not be displaced when holding with slight pressure. In lower tray perform the tongue movements right, left, forward and backward, on these movements tray should not be displaced.



Mark the sulcus depth in oral cavity with the indelible pencil. Insert the impression tray in oral cavity. Remove the tray and check the marks of indelible pencil transferred from the tissues to the tray. If the mark transferred on the inner surface of the tray flanges, then the tray is over extended need reduction of flanges. If the mark is on the boarder of the tray flanges, then the tray flanges are equal to the depth of sulcus also need reduction. If mark comes on the outer surface of tray flanges, then the tray is short and good for impression making.

PERIPHERY ADAPTATION

OBJECTIVES

Stability by recording boarders in harmony with oral structures
Reduce the saliva channel to increase retention
Support the checks to their pre extraction position for esthetics

First to border mold the final impression tray. In Border molding the tissues are moved against soft material that is supported and controlled by the tray.

Borders of the tray must be 2 mm short of reflection of tissue. The tray should always be checked in the mouth before border molding is started as the preliminary cast may have been more than 2 mm over extended. Green stick is added in sections, heated on a flame, tempered in a hot water bath, and placed in mouth. A properly molded green stick compo should have smooth, rounded and matt appearance.

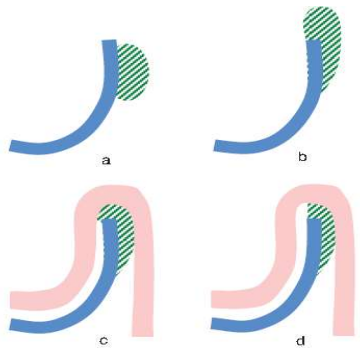
Soften the end of green stick on the burner by rotating it as to soften it all-round. Paint the soft green stick on the periphery of the impression tray in sections. Start from the right labial part in maxilla. Complete the maxillary peripheral adaptation in seven sections. That is, right labial, left labial, right buccal, left buccal, right tuberosity, left tuberosity and post dam area. Similarly, complete mandibular impression in eight sections. That are, labial section, right buccal, left buccal, anterior lingual, right lingual, left lingual, right retro molar area and left retro molar area.

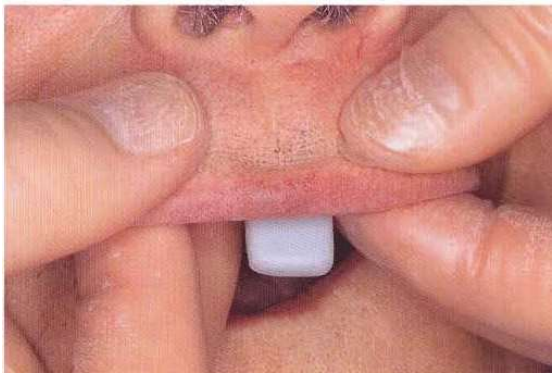
Always temper the low fusing compo in hot water bowl before placing in patient's mouth. Dry compo causes dry burning of mucosa which is very painful and slow healing injury. Remove any extra green stick flow on the impression surface of tray. On every section examine the molded periphery it should be 2-4mm rounded, smooth and have matt appearance.

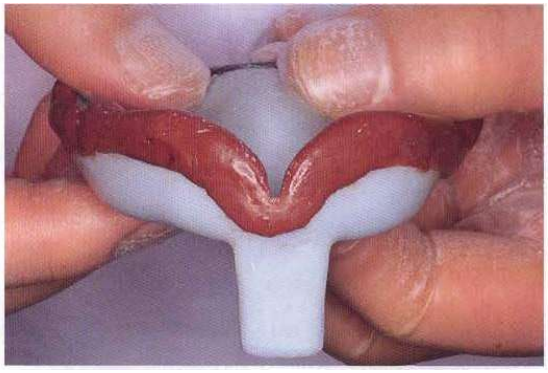
MAXILLARY BORDER MOLDING

Paint the low fusing compo on the boarders of tray and perform following movements of lips and cheeks in respective regions.

Upper lip outward, downward and inward
Buccal frenum - cheek outward, downward, inward, back and forward.
Disto buccal - cheek outward, downward, inward, move jaw side to side for coronoid process
Post palatal area (post dam area) - compo is paint on the tray over the vibrating line area and hamular notches. Place in mouth ask the patient to relax, swallow, relax and wide open the mouth. This border molding of post palatal seal will slightly displace soft tissue and enhance seal.







MANDIBULAR BORDER MOLDING

Anterior labial - lip outward, upward, inward
Buccal frenum - cheek outward, upward, inward, back and forward.
Buccal shelf -cheek outward, upward, inward.
Mandibular lingual flange

Anterior region - look for clearance of lingual frenum, sublingual folds, submaxillary ducts

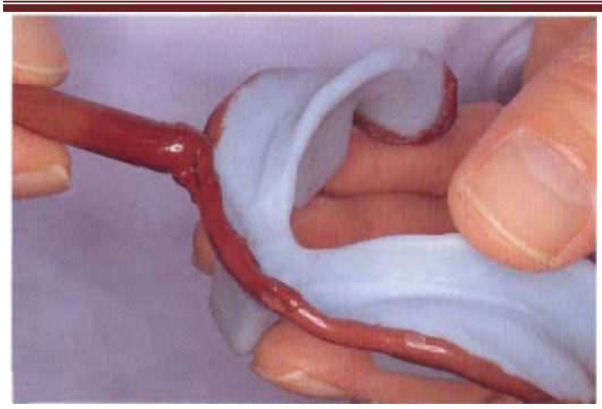
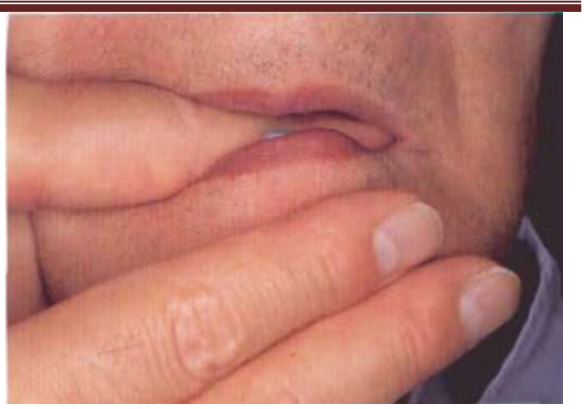
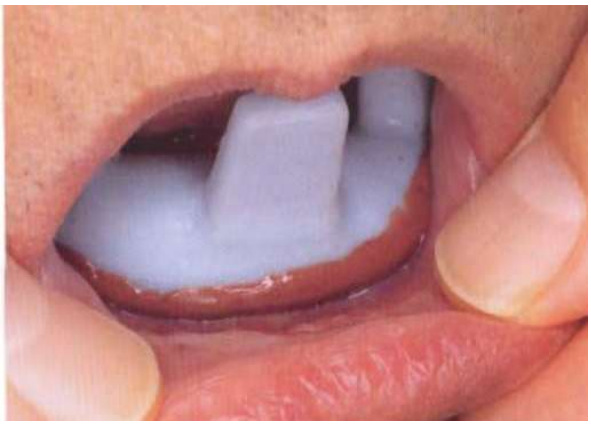
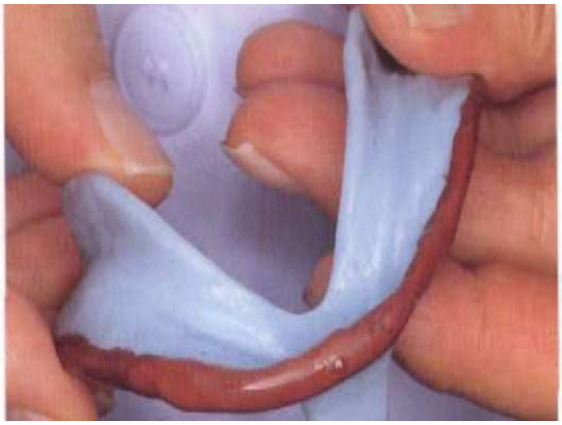
Apply green stick to anterior lingual flange. Ask the patient to touch the soft palate with tongue. Pre mylohyoid fossa area (canine - premolar area) - flange will extend below mylohyoid line in this area and will slope towards tongue. Add to molar regions between pre and post mylohyoid areas, Ask the patient to touch the corner of the mouth on opposite side (i.e., when applied stick on right side of tray touch the left side and vice versa). This allows action of mylohyoid muscle to shape the flange in this area.

At the distal end of lingual flange - add green stick and ask patient to touch the upper lip by tongue so that the retro mylohyoid curtain and superior constrictor muscle will shape the area. Also ask patient to close to contract medial pterygoid.

When finished, patient should be able to touch upper lip without much displacement of tray.

At the retro molar pad area and distal end of buccal flange applied green stick and ask patient to close mouth and press the tray downward, this allows the masseter muscle to trim the distal end of buccal flange and make masseter notch.

After completion of upper and lower boarder molding the impression trays should be retentive.

DIAGNOSTIC PERIPHERY CHECK UP

This is performed to conform that the periphery is correctly recorded. Before stating the wash impression with ZoE past, applied petroleum jelly on patients mouth around lips to prevent the adhesion of past.

Mixed and apply the ZoE impression past on the boarders of impression tray. Insert in patient's mouth and perform the same movements in same order and increments as for boarder molding. After setting of the past, remove the tray and check. If green stick visible through the past its show over extension of boarders. The sharp boarder of the past indicates under extension of periphery. Trim the overextended boarder with burs. Applied more green stick on under extended boarders and perform the same movements. This procedure is called diagnostic periphery check up

FINAL WASH IMPRESSION

OBJECTIVES

It records the fine details which Increase the surface area and also provide close contact of mucosa and denture which increases the adhesion and retention.

Squeeze the impression past on the glass slab in equal lengths. Mix the past with spatula till it become homogeneous in colour and consistency. Paint the mix in thin layer on whole surface of the impression tray including periphery.

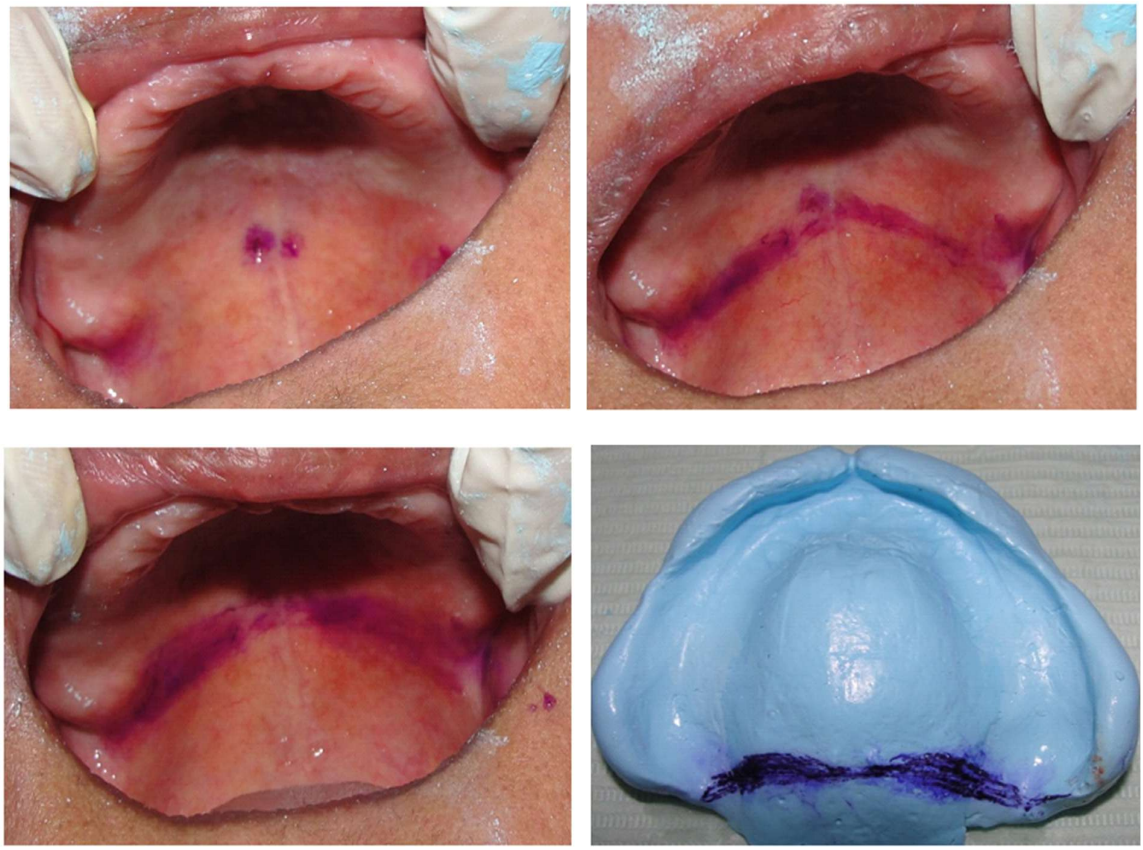
Seat the tray in patient's mouth first anterior then posterior and hold the tray in center of palate. After one minute, border mold in posterior and then the anterior regions. After 3-4

minutes remove the impression and inspect it. It should free of voids with no excess at borders. Any deficiency or defect can be corrected by applying past at defected area only.

In mandibular impression ask the patient to perform the same tongue movements as during boarder molding.

POST DAM MARKING

Take indelible pencil mark the hamular notches and foveae palptinae on patient's maxillary arch. Ask the patient to say prolong AH". Check the movements of the soft palate. Mark the line where movements start in soft palate. This is the vibrating line the posterior limit of post dam. The anterior limit is the junction between less compressible and more compressible tissues. It can be mark by palpating the mucosa with a 2mm ball burnisher. This junction may also be marked by clinically observing the color of mucosa. The colour of less compressible tissues on hard palate is whitish due to keratinization and more compressible tissues on soft palate are pink in color. Insert the upper impression and seat it on the upper arch and remove it. The mark will transfer on the impression



Marking of Post Dam Area

IMPRESSION MATERIALS

ALGINATE

Alginate is an irreversible hydrocolloid material i.e. a solid completely dissolved in water and can't be separated, as water sugar solution. It set as sol-gel reaction. Alginate impression material is a hydrocolloid that is made from seaweed. It is a powder that is mixed with water to create a viscous, gel-like substance that is used to take impressions of teeth and oral tissues. Alginate impression material is available in different viscosities, which determine the flow properties of the material. Lower-viscosity alginate impression material is more fluid and is used for taking impressions of the full arch, while higher-viscosity material is used for taking impressions of individual teeth.
Alginate impression material is a popular choice for taking dental impressions because it is easy to use, affordable, and produces accurate results. It is also safe for patients and does not require any special equipment or training to use.

1. **Biocompatibility:** Alginate is non-toxic and non-immunogenic, making it safe for use in medical and dental applications.
2. **Hydrophilicity:** Alginate can absorb and retain water, which makes it an excellent medium for recording detailed impressions of wet surfaces such as oral tissues.
3. **Gelation:** Alginate forms a gel when mixed with water and a calcium salt. The speed of this reaction can be controlled by the addition of retarders such as sodium phosphate.
4. **Elasticity:** The gel is flexible and elastic, which helps it to return to its original shape after deformation, ensuring accurate impressions.
5. **Biodegradability:** Alginate is environmentally friendly and can degrade naturally, adding to its appeal for eco-conscious industries.

COMPOSITION

INGREDIENTS	FUNCTION	QUANTITY
Potassium Alginate	Soluble alginate	15%
Calcium sulfate	Reactor	16%
Zinc Oxide	Filler Particules	4%
Potassium titanium fluoride	Accelerator	3%
Diatomaceous earth	Filler particles	60%
Sodium phosphate	Retarder	2%

CHEMICAL REACTION

The sodium or potassium alginate (insoluble alginate) reacts with calcium alginate in the presence of water and form an insoluble calcium alginate gel. The calcium ions replace the sodium or potassium ions making a polymer network.

MANIPULATION

16g of powder mixed with 38ml of water.
Gelation occurs in 3 to 4 min at room temperature (25^0C).
Higher the temperature shorter well be the setting time.
In a precool bowl first add water then powder. If powder is places first, penetration of the water to the bottom of powder is inhibited and greater mixing is required which reduces the working time and compromise the strength of setting material. Working time can be increased by using cold water.
A clean bowl and spatula are essential. As small amount of gypsum can accelerate the reaction as calcium is accelerator of the reaction.
The thickness of alginate in impression tray should not be less than 3mm. The thick layer of impression records good impression and have tear strength.
Impression should not be removed from mouth before at least three minutes as its strength and elasticity doubles in first 4 minutes.
6-7 min in mouth leads to distortion.
Remove the impression quickly as its increases tear strength.
Incorrect water powder ration weakens the gel and reduces elasticity.
Insufficient spatulation fails to dissolve ingredients and produce granular material.
Over mixing breaks up the calcium alginate network reduces the strength.

DISADVANTAGES

Not capable of reproducing fine details.
Dimensionally unstable as it absorbed water and also loose water by dehydration. Syneresis is shrinkage of impression due to evaporation of water. Imbibition is the swelling of impression due to water absorption.
Shrinkage also occurs due to thermal differential of temperature between mouth and room temperature. So, rapped the impression in a moist paper towel and sealed in a polyethene bag to shift the lab.
Compatibility with gypsum. Water content inhabits the setting of the gypsum at the surface. Sodium salt in alginate is a retarder of gypsum setting. (use 2% potassium sulfate solution as gypsum accelerator). This causes the roughness and chucky appearance of impression surface and distortion of margins of prepared teeth.
Impression surface should be free of visible water otherwise a chucky appearance of impression surface of model will be produced.
Cast should be removed in 30-60 minutes. Longer time dehydrate the alginate which become rigid and may abrade the cast surface.

ADVANTAGES

Easy to manipulate
Comfortable to patient
Relatively inexpensive

USES
Good for RPD
Study casts
Facial moulage
For primary impression in complete dentures.
Can be used as corrective impression on compo impression.

DISINFECTION
1 to 10 dilutions of house hold bleach.
Ionophores and synthetic phenols
After thoroughly rinsed, spray and rapped in disinfectant-soaked paper towel and placed in a sealed plastic bag for 10 min.

IMPRESSION COMPOUND

This is one of the oldest dental impression materials. It is a rigid, reversible impression material set by physical change. It is usually used for taking primary impressions of the edentulous ridge prior to the construction of a custom-made impression tray for complete dentures. Impression compound is available in disc and sticks of various colors, indicating different softening temperature ranges, e.g. greenstick compound (composition), these are used for impression correction and molding the borders of custom impression trays, particularly around muscle attachments.
Impression materials can be classified into two main types:

- Type I – Impression compound
- Type II- Tray compound

Type I – Impression compound
Type I compounds, are used primarily for edentulous patients to record the anatomy of the alveolar ridge and surrounding tissues. It is a thermoplastic material that becomes soft and pliable when heated and rigid when cooled.
It is typically supplied in the form of sticks or sheets that need to be softened in a water bath or a special impression compound heater. After softening, the compound is placed in a tray or directly in the patient's mouth to capture the impression. Although reusable, it cannot be sterilized and tends to become unhygienic and should not be reused ideally. It is nontoxic and nonirritant to the tissues.

Type II – Tray compound
Type II impression compound is also a thermoplastic material, but it is specifically designed for making custom impression trays. It is supplied in a form that is typically softer than Type I and in the shape of a tray (the custom tray for preliminary impression) that will later hold a second impression material, which will record the final impression (secondary impression). It is not in used now as the special trays now can be made by acrylic.

COMPOSITION OF IMPRESSION COMPOUND

A sample of impression compound comprises of:

- Natural or synthetic resin
- Waxes (Bee's wax, carnauba wax, Paraffin wax)
- Stearic acid, shellac, and gutta-percha
- Inorganic fillers/pigments

MANIPULATION

It is a thermoplastic material can be softened by heat. The fusion temperature is the temperature above which the material is soft and used for impression recording and below it is, hard cannot be used.

The thermal conductivity is very low, indicting the need for extended time to achieve thorough heating and cooling of compound. The material should be uniformly soft at the time to place in tray and thoroughly cool before removing from the mouth.

The material can be softened over a flame (low fusing green stick compound) or in a water bath (high fusing impression compound) at 65^0C. Overheating can remove the ingredients which are volatilize. Prolong immersion or over heating make the compound brittle and grainy as some of ingredients leach out of the material.

DIMENSIONAL STABILITY

With the increase in temperature relaxation of compound can occur in short period of time. The result is warpage or distortion of the impression. The pouring of the cast is recommended as soon as possible or within one hour.

DISINFECTION

2% alkaline glutaraldehyde solution is recommended.

USES

The impression compound is only used for edentulous patients as it is rigid material. The primary impression for custom tray making is recorded by it as it cannot record fin details. The high fusing compound, green stick, is used for boarder molding of the custom trays as it is easily molded by muscle manipulation.

ZINC OXIDE- EUGENOL IMPRESSION PAST

Zinc oxide eugenol is a rigid irreversible impression material composed of zinc oxide, eugenol, and other additives. It has good dimensional stability, fine detail reproduction, adherence to tissues, and shelf life.
Zinc oxide eugenol (ZOE) impression material is an irreversible nonelastic material used as a final impression (wash impression) in complete denture fabrication. It records the tissues in the undistorted state.

COMPOSITION

INGREDIENT	QUANTITY	FUNCTION
BASE		
Zinc oxide	87%	Main ingredient
Vegetable or mineral oil	13%	Plasticizer / offset the irritating effect of eugenol
CATALYST		
Oil of clove or eugenol	12%	Main ingredient
Gum or polymerized rosin	50%	Accelerator, smoothness
Filler silica particles	20%	Give body to mix
Resinous balsam	10%	Increase flow improve mixing
Accelerator solution CaCl + color	5%	Accelerator
Carboxylic acid / orthoexy benzonic acid (EBA)		Eugenol replacement for allergic patients

MANIPULATION:
equal lengths are squeezed out from both tubes on a paper pad or a glass slab and mixed with a broad-end spatula until they are mixed to an even color.

SETTING REACTION:
It sets in 3 steps:
First, the hydrolysis of Zn O with water takes place to form zinc hydroxide (water is required to initiate the reaction). The paste is freely flowing in this stage and can be loaded in tray.
The second stage is a typical acid-base reaction in which zinc hydroxide reacts with eugenolic acid to form zinc eugenolate, forming a chelate and water as a byproduct. The Zn O hydrate particles start reacting with eugenol and crystallization starts. At this paste can be molded in patient mouth. The paste can become cohesive and non-adhesive to hands.

The final set structure consists of Zn O particles embedded in the matrix of zinc eugenolate. The crystallization completes and paste no longer moldable or change shape and become harder. This is the time for impression removal from the mouth.
Humidity and temperature are the accelerators of the reaction. The working and setting time can affect the by environmental humidity and temperature. The working time can be increase by using cool mixing pad placed in refrigerator before mixing.

Dimensional stability: less than 0.1% shrinkage during hardening without any further change, i.e. very stable.

ADVANTAGES
It can record very fine details of the tissues.
It is easy to manipulate.
It has sufficient working and setting time.
Dimensionally table impression can be stored for a longer time period.
The corrections can be made in impressions without redoing whole impression by adding and readding.
It is compatible with impression compound, acrylic and plaster.
Impressions can be recorded in increments.
It is soft and freely flowing material so it cannot displace tissues, displaced itself and shows over extended areas in impression.
It can record all three types of impressions, i.e. mucostatic, muco compressive and selective pressure impression depending on the tray type.

DISADVANTAGES
Only use in special trays in thin layer.
It cannot flow beyond the tray boarders to fill the under extended areas.
It is messy inmixing and handling.
It can stain cloths.
It is sticky to patient face.
Its setting is affected by room temperature and humidity.
It is available in single consistency.
It cannot be used in undercuts.
Some patients are allergic to Eugenol.

USES:
Wash impressions (secondary impression) in complete denture fabrication.
Dual impression in distal extension partial dentures.
Bite registration paste
Surgical paste
Pressure indicating paste

Disinfection: 2% alkaline glutaraldehyde solution

ELASTOMERIC IMPRESSION MATERIALS

Elastomers refer to a group of rubbery polymers, which are either chemically or physically cross linked. They can easily stretch and rapidly recover their original dimensions when the applied stress is released.
Elastomers are required when precision is of utmost importance, like crown and bridge preparation and implants. Four types of elastomeric impression materials are available in the market: addition silicone, also known as polyvinyl siloxanes (PVS), condensation silicone, polyether, and polysulfide.
Elastomers can present in different consistencies, including putty, heavy body, medium body, and light body. The putty type is available in 2 jars containing base and catalyst. The medium body is dispensed in 2 collapsible tubes as base and catalyst. The light body is dispensed in syringes.

ADDITION SILICONE

Addition silicone are the most widely used impression materials in fixed prosthodontics.
Available in all consistencies i.e. extra-low, low, medium, heavy, and putty.

COMPOSITION:
All the consistencies are supplied as base and accelerator. The base contains hydroxy-terminated polysiloxane polymer which undergoes crosslinking, and fillers to control viscosity. The accelerator contains divinylpolysiloxane prepolymers, which are crosslinking agents, chloroplatinic acid, which is a catalyst, palladium, which is a hydrogen absorber, and fillers

SETTING REACTION:
The base paste containing hydrosilane-terminated molecules reacts with an accelerator paste containing siloxane oligomers with vinyl end groups and a platinum catalyst. A secondary reaction between the moisture and residual hydrides of the base polymer can lead to the development of hydrogen gas, it is not a reaction byproduct. This gas can result pin point voids in the gypsum cast that are poured soon after removing the impression from mouth. It is recommended to wait at least 30 minutes before impression pouring.

ADVANTAGES:

- Excellent dimensional stability - impressions can be stored before casting.
- Elastic recovery
- Great accuracy
- Short setting time
- Good tear resistance
- Auto mix available
- Hydrophilized addition silicone has good compatibility with gypsum
- The impression can be cast multiple times without jeopardizing the details.

DISADVANTAGES:

- Hydrophobic - the impression area must be dry to prevent inaccuracies in the impression.
- The sulfur present in the latex gloves and rubber dam may interfere with the polymerization of the base and catalyst.
- Hydrogen gas may lead to pitting in the cast.

INDICATIONS:

- Fixed prosthesis: crown, bridges, implant
- Maxillofacial prosthodontics
- Occlusion registration

CONDENSATION SILICONE

Condensation silicone is more affordable than other elastomeric materials but has the disadvantage of being prone to shrinkage, requiring immediate pouring. Available in consistencies as extra-low, Low, medium, and putty

COMPOSITION:

The base contains hydroxy-terminated polydimethylsiloxane, which forms a polymer, and fillers that control viscosity. The accelerator contains tetraethyl silicate and tin octoate (catalyst).

SETTING REACTION:

Condensation polymerization reaction occurs with the release of alcohol as a byproduct that evaporates as it is formed. As alcohol evaporates, it causes contraction in set impression material. It is recommended to pour impression immediately after removal from mouth.

ADVANTAGES:

- Good elastic recovery
- Pleasant odor and taste
- Accurate reproduction

DISADVANTAGES:

- Dimensional deformation over time
- Hydrophobic
- Dimensional stability is affected due to reaction byproducts.

INDICATIONS:

- Fixed prosthesis: crown, bridges, implant
- Maxillofacial prosthodontics
- Occlusion registration

POLYETHER

Polyether has become popular because it only requires a stock tray and a single mix. Available as light, medium, and heavy body consistencies.

COMPOSITION:
The base contains polyether, fillers, and plasticizers. The accelerator contains alkyl aromatic sulfonates, inert oils, and plasticizers.
Setting reaction:
When base and accelerator are mixed in equal proportions, polyether rubber is formed.

INDICATIONS

- Fixed prosthodontics (crown and bridgework, particularly for multiple preparations)
- Implants
- Border molding in complete denture fabrication
- Indirect inlay and onlay impressions
- It can be used for corrective impressions as it can be added to previously set material.

ADVANTAGES:

- Hydrophilic
- Accurate and high-dimensional stability enables the delay of casting and allows for multiple pourings.
- Good elastic recovery
- Good compatibility with gypsum
- Good shelf life
- It can be used as a single-phase material or with a syringe tray technique

DISADVANTAGE:

- The most rigid of all the elastomers makes it hard to remove (newer polyethers are slightly more flexible)
- May cause allergy due to sulfonate acid esters.
- The impression should not be immersed in disinfectant for more than 10 minutes since it's hydrophilic and absorbs water.

POLYSULFIDE

Polysulfides are the first elastomers to be introduced. Although messy to manipulate, it is useful when a long working time is needed. Polysulfides are not recommended except for complete dentures. Available in consistencies of light or heavy body.

COMPOSITION:

The base contains polysulfide prepolymer, filler for strength, plasticizer for optimum consistency, and sulfur as an accelerator

The catalyst contains lead oxide (gives a characteristic brown color), fillers, plasticizers, and retarders

SETTING REACTION:

The polysulfide prepolymer reacts with lead oxide, forming polysulfide rubber and water. The reaction byproduct significantly affects the dimensional stability of the impression; therefore, the impression should be cast immediately. Polysulfide is the most flexible of elastomeric materials, and it can be easily removed from undercut areas.

ADVANTAGES:

- Least rigid (most flexible of all the elastomers)
- Good tear strength
- Most biocompatible
- Excellent flow, so good reproduction of details
- Hydrophilic

DISADVANTAGES:

- Requires a custom tray
- Long setting time
- Must be poured within half an hour
- Hydrophobic
- Bad odor
- Unpleasant taste
- Stains the clothes
- Messy to work

INDICATIONS:

Only recommended in complete denture cases for secondary impressions.

DIMENSIONAL STABILITY

This is the property of impression material to resist the changes from mouth to lab. without any permanent deformation. The dimensional changes can be any one of following type.
Polymerization shrinkage
Loss of by products
Thermal contraction from oral to room temperature
Imbibition due to water, disinfectant or humidity
Incomplete recovery of deformation because of viscoelastic behavior
Polysulfide and condensation silicon should be poured immediately after removal from mouth as release of byproducts cause shrinkage if the impression.
Additional silicon and polyether should not be poured immediately (not before 1 hour) as the secondary reaction with moisture can affect the impression, let the polymerization be completed.
Polyether absorbs water or fluids and simultaneous leaching of water-soluble plasticizers so it should not immerse in disinfectants or left the water inside the impression.

RHEOLOGICAL PROPERTIES

Polysulfides has the lowest viscosity and ranks as the least stiff of the elastomeric impression materials. This flexibility allows the set material to easily remove from the undercuts with minimum stress.
Additional silicon and polyether are pseudoplastic impression materials. The clinician can use a high viscosity material which is more stable and resistant to distortion and low viscosity material on it for fine details to record.
Elasticity
Elastic properties of elastomeric impression materials improve with an increase in curing time in the mouth. The longer the material remain in the mouth the less distortion will occur during impression removal.
If a large dimensional change occurs beyond the elastic limit, it will not return to its original shape it is permanent. Additional silicon is best in this property. The stiffness increases to polysulfide, condensation silicon, additional silicon and polysulfide.

TEAR STRENGTH

Resistance to tear increase in order hydrocolloids, silicones, polyether and polysulfide.

MAXILLOMANDIBULAR RELATIONSHIP RECORDS

OBJECTIVES

To restore the lower facial height at pre-extraction position so that patient can chew and speak normally and also restore esthetics.

Each individual has a unique relationship among maxillary and mandible ridges and temporomandibular joints. Function properly each prosthesis should be individually configured in the physiological environment dictated by the unique relationships among each patient's maxillary and mandible ridges and temporomandibular joints. Properly designed and adapted base plates and physiologically configured occlusion rims are necessary for making an accurate and stable record of inter occlusal relations and for communicating instructions to the laboratory technician that will determines tooth placement.

TYPES OF RECORDS

1-Vertical relation record
2-Orientation record
3-Horizontal relation record
  a- Centric relation record
  b- Eccentric relation record
    I- Protrusive relation record
    II- Right relation record
    III- Left relation record

VERTICAL DIMENSION RECORD

It is the distance between the maxilla and mandible supported by teeth and alveolar bone.

This determines the length of the muscles attached between maxilla and mandible. To function properly the muscle, need this fixed distance between their two-end supported by natural or artificial teeth. To rehabilitate edentulous patient, it is required to restore this distance so the muscle can work.

There are two vertical dimensions i.e. rest vertical dimension RVD and occlusal vertical dimension OVD.

OCCLUSAL VERTICAL DIMENSION OVD

The occlusal vertical dimension OVD is the distance between maxilla and mandible when teeth are occluded. It is depended on the presence of teeth. This dimension is lost with the teeth. The objective is to restore this OVD.

REST VERTICAL DIMENSION RVD

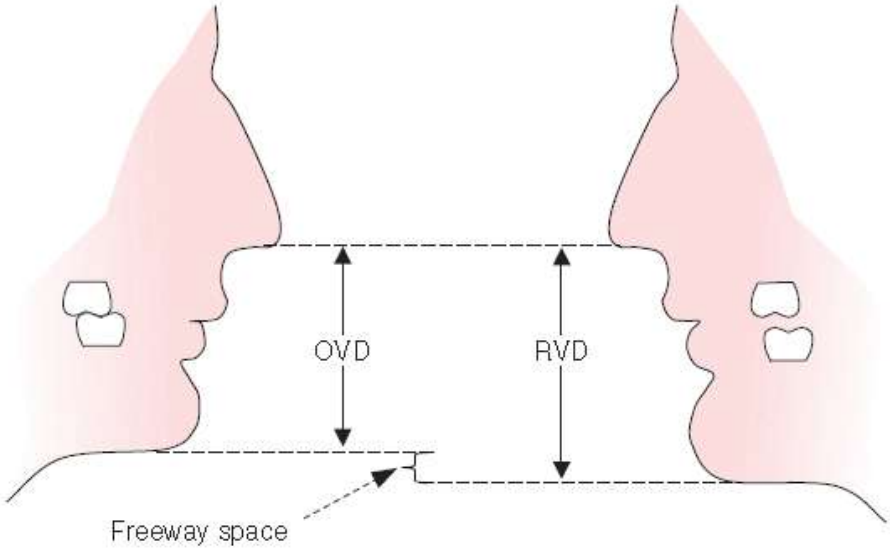
It is the postural relation and it is the distance between the mandible to the maxilla when the patient is resting comfortably in the upright position and the condyles are in a neutral unstrained position in the mandibular fosse.

The rest vertical dimension is dependent on the muscles. The mandible is considered to be in the physiological rest position, when all the muscles that close the jaws and all the muscles that open the jaws are in a state of minimum tonic contraction, sufficient only to maintain posture and to resist the force of gravity. Since gravity exerts a force on the mandible, this force is added to the force from the muscles applied to the mandible.

Any conditions which affect the muscles also affect the RVD. Patient's posture, local, systemic and mental condition can alter the RVD.

INTER OCCLUSAL DISTANCE OR "FREEWAY SPACE"

In resting position there is a space exist between the upper and lower teeth this is called freeway space or inter occlusal distance. In other words, distance between the Rest Vertical Dimension and the Vertical Dimension of Occlusion is termed the Inter occlusal distance or "freeway space". Freeway space varies from 2-8 mm but most patients tolerate a space in the 2-4 mm. The freeway space is the nature's protective mechanism to protect the teeth and periodontium from continuous heavy occlusal load by the continuous teeth contact. Any violation of freeway space stimulates the bone resorption to achieve a freeway space.



HOW TO RECORD OVD

Our objective is to restore the OVD. The problem in edentulous patient is that with the tooth loss OVD also lost as it depends on teeth. On the other hand, we have RVD which depends on muscles and remained unchanged after loss of teeth. The difference of OVD and RVD is the freeway space which is added in RVD. If we record the RVD and then reduce the freeway space from it, which we know is 2-4 mm, then we can get the OVD.
This is most controversial procedure in Prosthodontics. As the actual dimension has lost with the loss of teeth and dentist has to restore the true vertical dimension of occlusion. There are so many methods available to guide the operator to record OVD. All these methods are not applicable to all patients. So, it is advisable to use two or three methods on each patient to verify the adjusted OVD.

FACTORS AFFECTING THE RVD

SHORT TERM FACTORS

HEAD POSTURE

Backward bending of the head stretches the muscles and increases the RVD. Similarly, forward bending of head reduces the RVD. It is advised to keep the head straight and unsupported during recording of RVD.

STRESS

Mental stress and tension increase the muscles contraction and reduces the RVD. Keep the patient calm and stress-free during procedure. In depressed and tense patient antidepressants can be prescribed.

PAIN

Pain also contracted the muscles and reduces RVD. Before starting the procedure examine the impression surface of base plate for any acrylic bulb sharp margin. Make the base plates completely comfortable to patient before starting RVD record.

RESPIRATION

Inhalation reduces the RVD and exhalation increases the RVD, but respiration has a very minor effect on RVD.

LONG TERM FACTORS

AGE AND HEALTH

Old age and poor health both have similar effects on the body. Old age and poor health reduce the muscles tone and dropping of mandible due to gravity increases the RVD.

PARA FUNCTIONS

Bruxism and Clenching change the tone of the muscles. In these patients hypertrophy of muscles is commonly seen. Para function habits usually decrease the RVD by continuous muscle contraction.

EFFECTS OF INCREASED VERTICAL DIMENSION

TRAUMA TO THE TISSUES

Increase vertical height eliminates the freeway space and cause continuous teeth contact. This contact applied excessive pressure on the soft tissues continuously. This continuous pressure compresses the blood vessels decreases the blood flow to tissues and leads to tissue trauma.

INCREASED OF BONE RESORPTION

Encroachment on the freeway space also results in abnormal pressure on under lying bone. This continuous pressure stimulates the bone resorption to restore the freeway space. This leads to loss of bone and decrease of ridge height and compromise retention and stability of dentures.

CLICKING SOUNDS

The oral cavity has limited space and muscles are used to function in this space. During speech muscles are programmed to elevate the mandible to certain distance to produce different sounds. When this space occupied by the long dentures and muscles contract according to old position, upper and lower dentures strike each other and produce clicking sounds.

SPEECH DEFECTS

Increasing the vertical height of dentures changes the physiology of oral cavity. During speech sounds are produced by contact of tongue at different positions in oral cavity. These all contacts are programmed and any change in this change the sounds of different words.

POOR ESTHETICS

Increase in vertical height of dentures increases the height of lower face causes disproportion in face. More teeth are visible in resting position and patient appears smiling all the time.

TMJ PROBLEMS

Increase in vertical height open the mouth causes the muscles in continuous contraction which leads to fatigue. This fatigue also occurs in lateral pterygoid muscle acting on the condylar disc cases displacement of disc and pain in TMJ.

EFFECTS OF REDUCED VERTICAL HEIGHT

POOR ESTHETICS

Decrease in the lower face height increases the creases and folds on the face. Reduce distance in nose and chin causes the aged appearance of the patient.

MASTICATORY INEFFICIENCY

To function affectively the muscles should be supported to their length. Reduce in muscles length reduces the muscles tone and its strength and leads to reduce efficiency.

ANGULAR CHEILITIS

Reduced nose chin distance increases the angular folds. These folds are moistening by the dropping saliva from the mouth due to reduce vertical height. The continuous wetting of these folds promotes fungal growth and leads to angular cheilitis.

CHEEK BITING

Reduce vertical height increases the freeway space and reduces muscles tone. These have decrease support and become flabby. These flabby muscles trapped between the occlusal surfaces of the dentures due to increased freeway space and check biting occurs.

TMJ PROBLEMS

Over closure of the mandible pushes the condyle backwards on the retro discal tissues. These tissues are innervated by pain nerves and this compression leads to trauma and pain in TMJ.

EFFECTS OF INCREASED VERTICAL DIMENSION	EFFECTS OF REDUCED VERTICAL DIMENSION
TRAUMA TO THE TISSUES	POOR ESTHETICS (aged appearance)
INCREASED BONE RESORPTION	MASTICATORY INEFFICIENCY
CLICKING SOUNDS	ANGULAR CHEILLITIS
SPEECH DEFECTS	CHEEK BITING
POOR ESTHETIC (smiling face)	
TMJ PROBLEMS	TMJ PROBLEMS

METHODS TO RECORD VERTICAL DIMENSION RECORD

These methods can be classify as followed

A-PRE-EXTRACTION RECORD

I. Photographs
II. Cast of teeth
III. Radiographs
IV. Facial measurements
V. Facial tracing
VI. Former dentures

B-POST EXTRACTION RECORDS

1-MECHANICAL METHODS

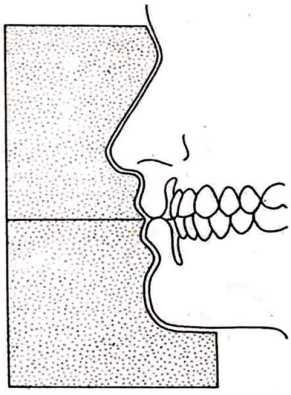
I. Incisive papilla relation
II. Facial measurements
III. Ridge parallelism
IV. Cephalometric tracings

2-PHYSIOLOGICAL METHODS

I. Physiological rest position
II. Phonetics (minimum speaking space)
III. Esthetics
IV. Swallowing threshold
V. Tactile sense & Comfort
VI. Muscular force Bi meter

A-PRE-EXTRACTION RECORD

These records can be obtained from patients but these are not very reliable. In old photographs and radiographs of young time the vertical height is not reliable because nature reduces the vertical height with increasing age by attrition of teeth. Facial measurements and tracings can be recorded before patient become edentulous it can to done by a dentist planning to provide complete dentures and patient having contact points between both arches. The facial tracing can be recorded by adapting a soft wire to the face from hair line to base of chin. Then this tracing placed on a hard board and cut the board according to this tracing. This hard-board tracing can use for future record. The old dentures are most unreliable for any jaw relation record because attrition of acrylic teeth and changes in basal seat changes the orientation of dentures.



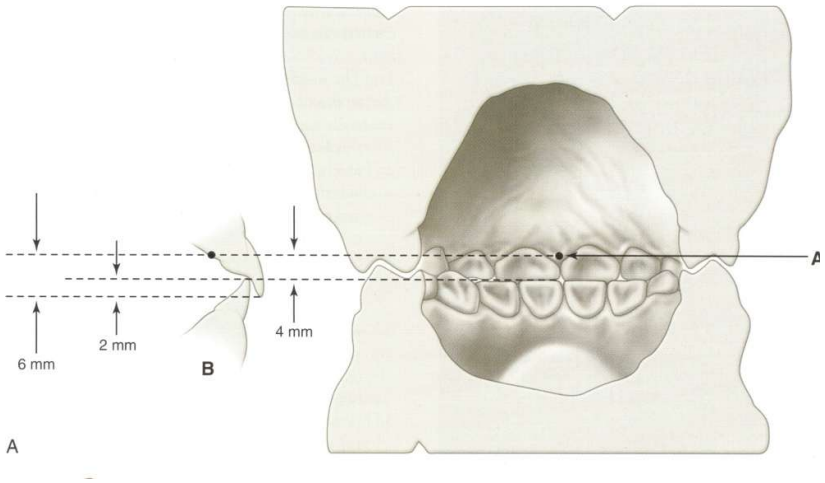
METHODS OF VERTICAL RELATION RECORDS

PRE-EXTRACTION RECORD	POST-EXTRACTION METHODS	
	MECHANICAL METHODS	PHYSIOLOGICAL METHODS
Photographs	Facial measurements (Willis Method)	Physiological rest position (Niswanger's Method, two dot Method)
Cast of teeth	Incisive papilla relation	Phonetics (minimum speaking space)
Radiographs	Ridge parallelism	Esthetics
Facial measurements	Cephalometric tracings	Swallowing threshold
Facial tracing		Tactile sense & Comfort
Facial tracing		Muscular force Bi meter

MECHANICAL METHODS

INCISIVE PAPILLA RELATION

Incisive papilla is a biometric guide. Its relation with teeth can be used as a reference to adjust the rest vertical dimension. In dentate persons with Class I occlusion the distance recorded between incisive papilla and lower incisor edge is 4mm and with upper incisor edge is 6mm. To add the bone resorption after extraction it is recommended that the distance of edge of upper occlusal rim should be 8-10mm from incisive papilla. This guide is helpful in new edentulous patients with minimum bone resorption. In edentulous patient with greater bone resorption this guide becomes unreliable.



Incisive papilla Relation

FACIAL MEASUREMENTS WILLIS METHOD

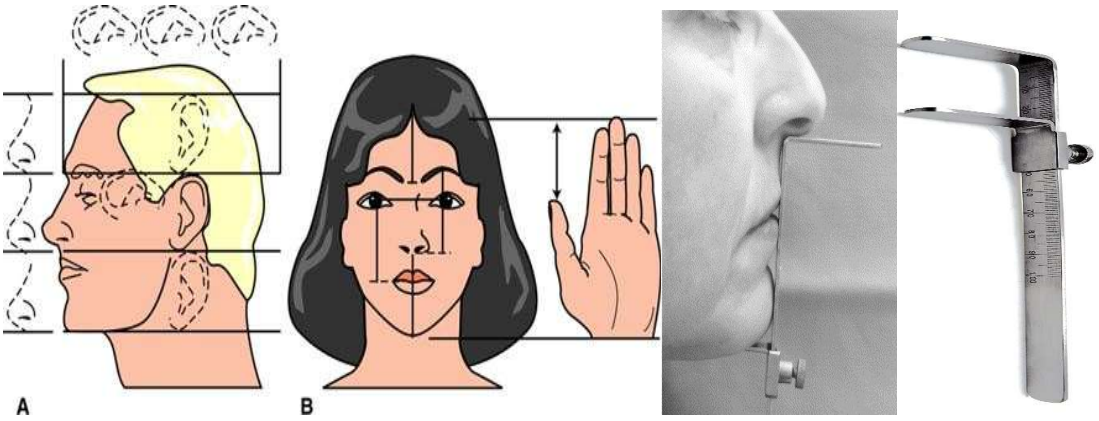
Willis presented the theory that the face has equal proportion if divided in three halves i.e. hairline to bridge of nose, bridge of the nose to base of ala and base of the ala to base of the chin. To record these Willis also design a gauge, called Willis's gauge.

The different measurements on face are also used by artists in face drawings. With time other measurements are added in this series.

Following are the common measurements use to establish RVD.

Hair line to bridge of nose (glabella)
Outer canthus of eye to corner of the mouth
Bridge (glabella) of the nose to base of the ala
Upper margin of the eye brow to base of the ala
Centre of pupil to boarder of upper lip line
Base of the ala to base of chin
Length of the ear
Distance between outer canthus of eye to tip of apex of tragus

It is recommended to measure at least three distances and then adjust the Base of the ala to base of chin according to an average distance of there.



Willis Gauge

RIDGE PARALLELISM

The paralleling of the maxillary and mandibular ridges, plus a 5-degree opening in the posterior region as often gives a clue to the correct amount of jaw separation. Since the clinical crowns of the anterior and posterior natural teeth have approximated the same length, their removal would leave the residual alveolar ridges nearly parallel to each other. This can also be used as a conformation to the recorded OVD, after articulation of the recorded vertical height, remove the bases from the articulated cast and check the parallelism of the cast. Any greater degree of inclination needs verification of the record.

CEPHALOMETRIC TRACINGS

The cephalometric tracings of the edentulous patients can be helpful in measuring of the RVD. The distance between two points on tracing can be applied on face for adjustment of occlusal rims. Distance between a point on nose and other on chin measured from the tracing and then same distance adjusted on patient with occlusal rims.

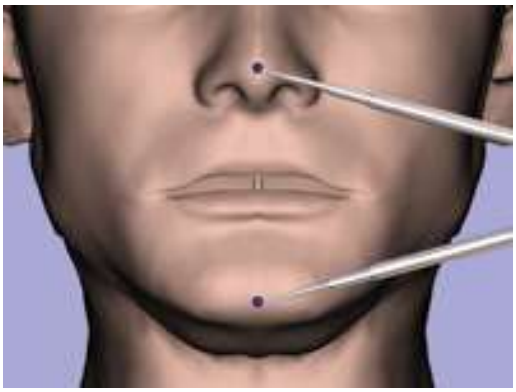
PHYSIOLOGICAL METHODS

PHYSIOLOGICAL REST POSITION OR NAISWONGER OR TWO DOT METHOD

Physiological rest position is the postural relation of the mandible to the maxilla when the patient is resting comfortably in the upright position and there is no teeth contact. This method depends on patient's muscles and only applicable where patients have good muscle tone. In very old patients and patients with muscle disorders are not suitable candidates for this method.

Cut two small triangles of tape and place one on the tip of the nose and the other on the chin at the midline on least movable part so that their apices face one another or mark two dots with indelible pencil. Direct the patient to sit upright, free of any back or head support and relax. Ask the patient to count slowly from 1 to 10. Then direct the patient to moisten the lips and swallow and relax. Measure the distance between the apices of the tape or dots with a ruler or a Bouley's gauge. Repeat the measurement several times until a consistent result is obtained. This is rest vertical dimension. Minus 2-3mm from this. Record this measurement as OVD.

PHONETICS (MINIMUM SPEAKING SPACE) METHOD

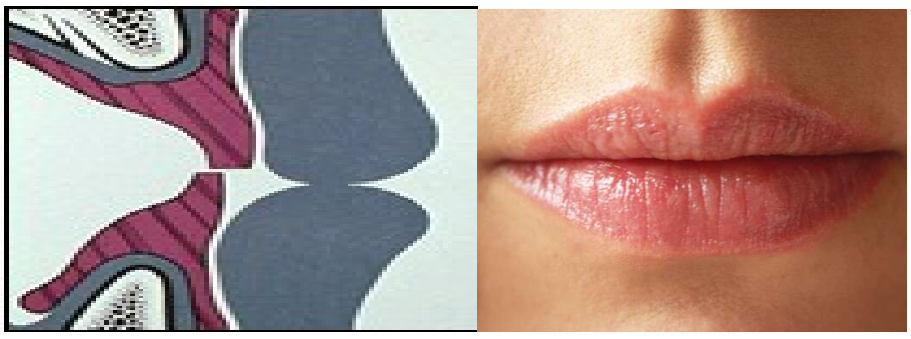


A space remains between the upper and lower teeth during speech when the mandible is maximum elevated. This is called minimum speaking space and it is of 1mm. Speaking range is the space occupied by the mandible while various phonetic sounds of any language are made. It is different from freeway space in that it is a functional space and of only 1mm while freeway space is existed in resting and of 2-4mm. This space can be check by taking to the patient. In high vertical the wax rims collide during speech and in low vertical height more space visible during speech.

The freeway space establishes vertical dimension when the muscles involved are at complete rest i.e. Physiological Rest Position. The closest speaking space measures vertical dimension when the mandible and muscles involved are in function. In first method everything involved is at rest and in second everything is in motion (Functional).

ESTHETICS

A junction is visible on the lips where pink inner oral mucosa meets with outer dark epithelium of vermilion boarder. In normal dentate person in resting the upper and lower lips meet each other at this junction. In high vertical dimension the inner pink mucosa more visible and in reduced vertical dimension only outer dark epithelium visible. In high vertical dimension an uncomfortable stretching of the face is seem while in low case increase in facial creases observed.



SWALLOWING THRESHOLD

In normal swallowing, at the end of cycle, the mandible lifted up to its normal vertical height. Any increase or decrease in vertical height disturbs the swallowing cycle. This can be check by asking the patient to swallow the saliva and ask for response after adjusting the wax rims. The swallow threshold can be used to record the vertical dimension of occlusion. After adjusting the

upper occlusal rim make three elevations on the lower base plate by soft wax as carnauba wax. Put the both rims in patient mouth and ask for swallowing the saliva. Repeat these many times. The soft carnauba wax will be adjusted by the movements of the mandible to normal vertical height where mandible stops every time.

TACTILE SENSE & COMFORT

Patient's tactile sense can be used by asking the patient about how feels after adjustment of rims. Patient can tell the position where comfortable feels. This is only helpful in cooperative and intelligent patients.

MUSCULAR FORCE BI METER

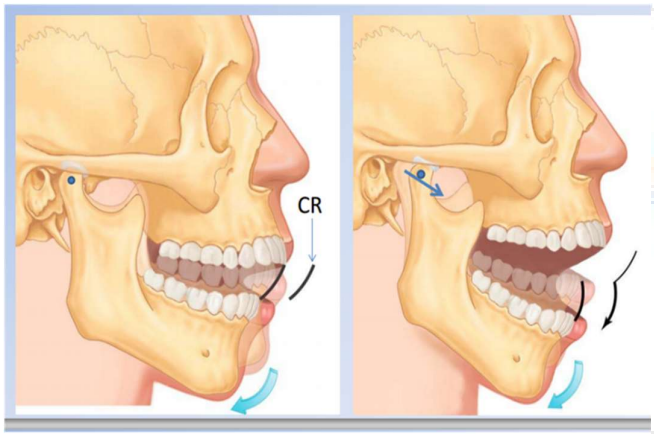
There is a critical point found in the distance from origin to insertion of a muscle at which the muscles of mastication can exert the greatest force in contraction. If the distance is increased or decreased the muscle has less efficiency. The theory is based on the premise that the muscles of mastication exert their greatest degree of force when their origin and insertion are at exact distance apart. The instrument is used to record this position is called Bimeter. The device is set that the jaws are separated to an excessive degree of opening and the patient is instructed to bite with all his power. The force is registered on the dial of the Bimeter which is noted on the paper. Where the maximum reading is found at that point the vertical height is adjusted. Latest research rejected this theory and maximum force of muscle is found at higher than the rest vertical height by electromyography.

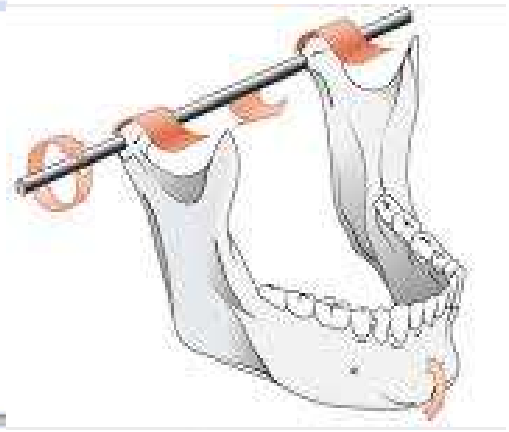
ORIENTATION RELATION RECORD

The maxillary arch occupies a specific position in the cranium and the mandible is related to the cranium in a specific manner by way of the mandibular fossa of the temporal bone. To record the position of the maxilla in relation to base of the skull and condyle of mandible and orient the maxillary cast on the articulator in the same position is the orientation relation record. The instrument used to record this position is called Face Bow.

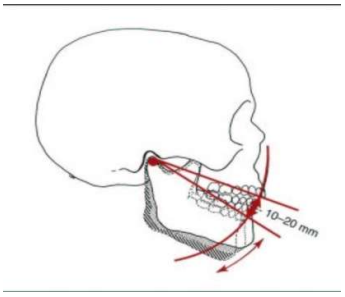
It is the relation in which we orient the cast to the articulator in the same relationship as the opening axis of the mandible.

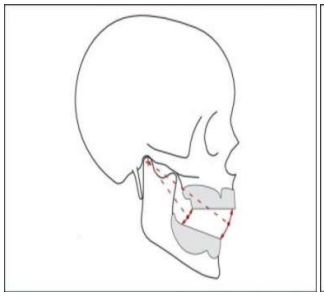
The mandible movements have two components i.e., rotation and translation. During opening the mandible's both condyles rotate on one axis till 10mm of inter incisal opening. This is rotation of condyles and the point where one line can pass from both condyles during rotation is called opening axis of the mandible. This rotational movement occurs between the condyle and articular disc. After this the condyles with the disc move forwards on slops of articular eminences. This movement is translation.

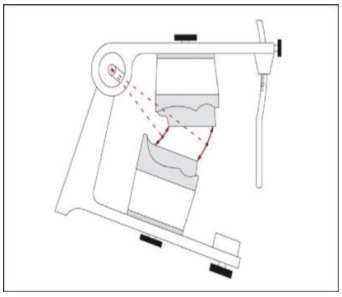




Rotation Translation Hinge Axes



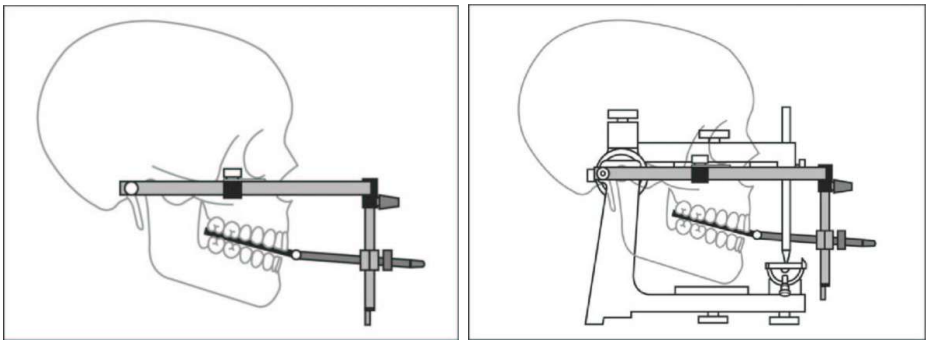




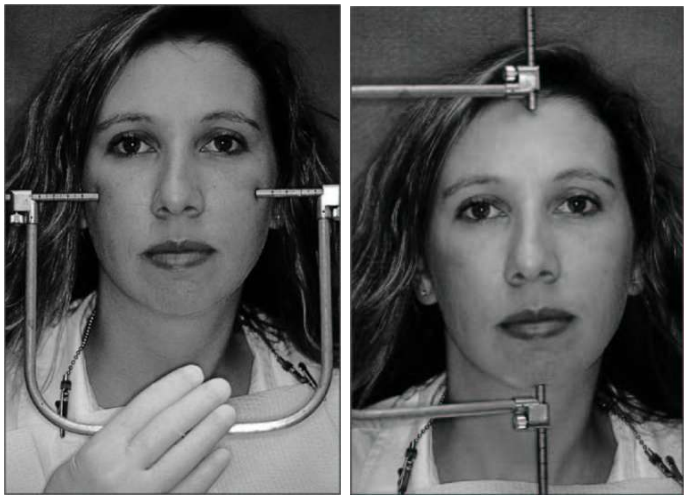
The instrument used to record this position is called Face Bow so this is also called Facebow Records.

FUNCTIONS OF FACE BOW

Record the position of maxilla in relation to base of skull
Record the position of maxilla in relation to condyles
Record opening axis of the mandible
Record the inter condylar distance and other facial distance.
Help in mounting the cast on articulator



Record the position of maxilla in relation to base of skull



Record the inter condylar distance and other facial distances

PARTS OF FACEBOW

Face bow help to record the three-dimensional position of the maxilla and transfer it to the articulator in the same position. The Face bow has a

U-SHAPED FRAME

The U-shaped main frame holds all other parts together.

CONDYLAR RODS

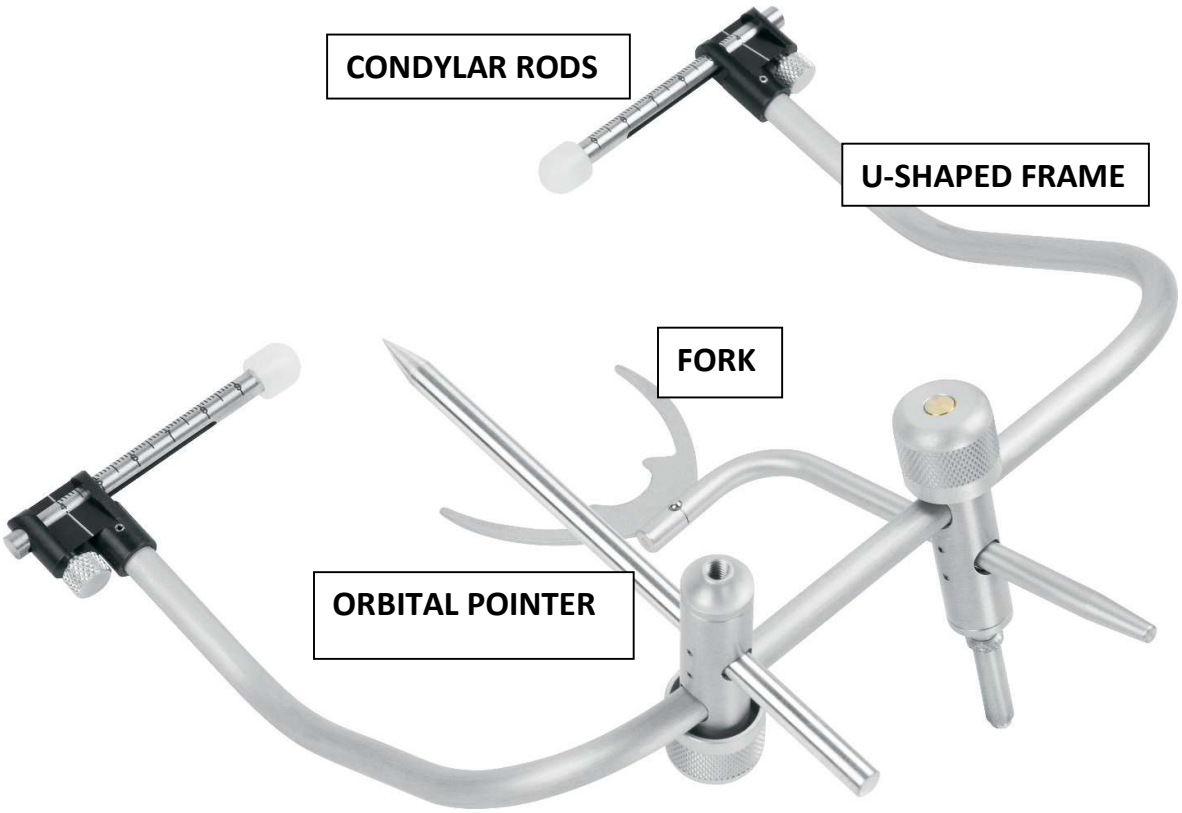
Two condylar rods one on each end of u-shape frame and marked by mm. They can move in and out direction. They used to record the lateral i.e., right to left position of maxilla.

FORK

Fork holds the upper occlusal rim or attached with upper teeth and records the anterior posterior position of maxilla.

ORBITAL POINTER

Orbital pointer records the vertical position of maxilla in relation to base of skull. It adjusted on infra orbital foramen.



TYPES OF FACE BOW

There are two types of Face bow

Arbitrary Face bow

Kinematic Face bow

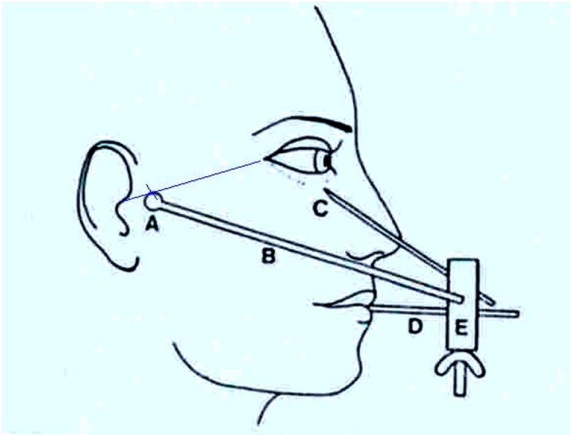
Arbitrary face bow is less precise in locating the opening axis of condyles and more use full in removable Prosthodontics.

Kinematic Face bow in more precise and can locate the true opening axis and used in fix Prosthodontics. Hinge axis or opening axis is the center of rotation around which mandible rotates in its rotational movements. Kinematic Face bow is first applied on the mandible only to locate the hinge axis of condyle, then it is applied on maxilla and record the position of maxilla according to hinge axis.

FACE BOW RECORD TRANSFER

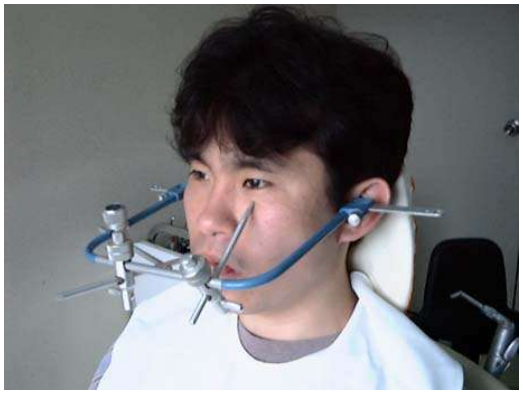
Separate the bite fork from the face-bow, softened the wax rim from occlusal surface and attach the fork to the wax rim so that it's handles projects from the midline of the rim. Mark two lines on patients face to locate the condyle. Mark first line from outer canthus of eye to apex of the tragus. Cut this line with second line at 13mm in front from inner boarder of apex of tragus. This is arbitrary location of condyle; on this basis it is called arbitrary face bow.

Insert the contour rim attached with fork into the mouth. Adjust the condylar rods of face bow on these marks. Place the bow into position by sliding it onto the fork handle. Center the face bow by adjusting the distance on condylar rods equal on both sides to record the lateral position of maxilla.



Position the orbital pointer at the infra orbital foramen, this is for vertical position record. Now tighten the 2 screws on the front of the face-bow in sequence for fork and pointer. Repeat the sequence to make the screws extra tight as they are prone to loosening up. Loosen the condylar rods then remove the entire face-bow from the mouth.

Adjust the face bow on the articulator. Attach the condylar rods of face bow on condylar rods of articulator. The orbital pointer should be at the same height of upper metal rim of the articulator or at orbital plane if provided on articulator.



Center the face bow on articulator by adjusting the distance on condylar rods equal on both sides.

Support the face bow in this relation on the articulator. Seat the notched and lightly lubricated maxillary cast into the baseplate and mount the cast. Now the maxillary cast is oriented on the articulator is same position as on face.

CENTRIC RELATION RECORD

Horizontal relations of the mandible with maxilla are the centric relation, protrusive relation and lateral relations.

CENTRIC RELATION

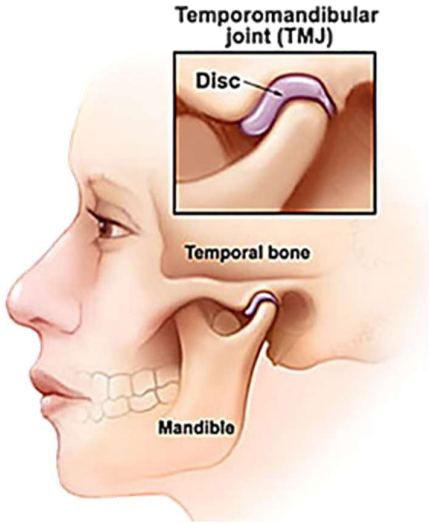
The centric relation is the most superior and most anterior unstrained position of the condyle in the glenoid fossae at established vertical dimension. It is a bone to bone relation and teeth have no effect on it. It is the relation which remains constant for every person and can be recorded repeatedly at same position, provided the soft tissue structures in the Temporomandibular joint are healthy. It is also called Retruted contact position.

CENTRIC OCCLUSION

Centric occlusion is the relation of the maxillary and mandible teeth when condyles are in centric relation. Centric occlusion is relation of teeth and lost with loss of teeth. It is the most preferable relation to record for prosthesis where it can record.

MAXIMUM INTERCUSPATION

It is the relation of maxillary teeth with mandible teeth when in maximum intercuspation regardless of condyles position i.e., condyles may or may not be in centric relation.



When the teeth loss the choice is to record the centric relation. It the resting position of the mandible whenever mandible is not moving it goes to centric relation. It is also the starting and ending position of all mandible movements. So, it is the most suitable position to establish an occlusion for edentulous patient.

METHODS TO RECORD CENTRIC RELATION

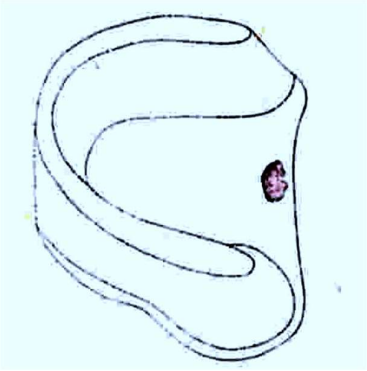
Centric relation record is dependent on muscles control. Due to prolong edentulous state patient adapt abnormal habits to approximate the ridges for chewing by protruding the mandible. These abnormal habits change the normal muscle movements. When recording centric relation, muscles show resistance to retrude the mandible due to the habit of protrusive biting. Patient confusion to follow the instruction also creates difficulties. The unstable and non-retentive and uncomfortable bases also create problems to record centric relation.
There are different methods to record the centric relation which can be use according to patient's status.

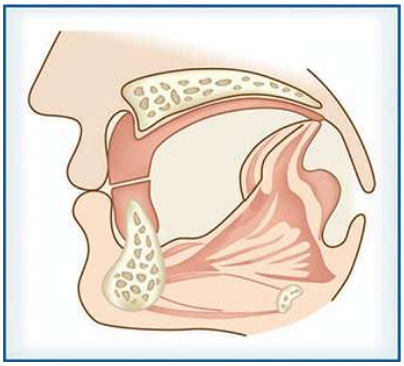
PATIENT INSTRUCTIONS

Simplest and easiest way is verbal instructions. Instruct the patient to close the posterior teeth. Instruct the patient to get the feeling of pushing his upper jaw out and close at back teeth.

TONGUE RETRUSION

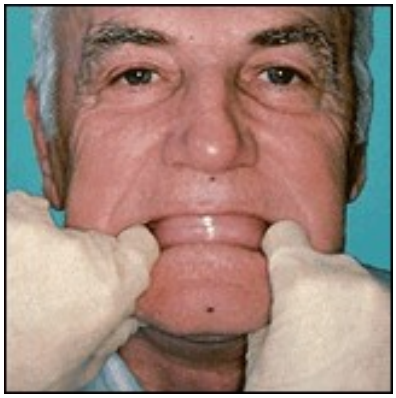
Touching the soft palate with tongue lift up the floor of mouth and push the mandible backward in centric relation. Ask the patient to turn the tongue backward and touch the posterior border of the upper base plate and close the mouth. A wax stopper can be placed on posterior boarder of upper base plate and instruct the patient to touch the wax with the tongue.





CONTROL OF THE MANDIBLE

Manually hold the mandible and push it gently backward to centric relation.



SWALLOWING

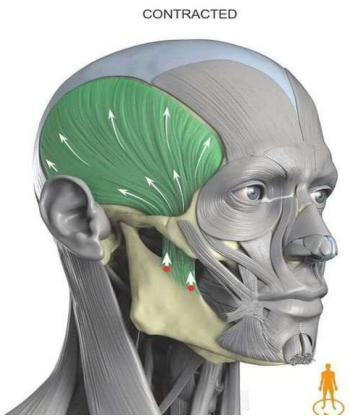
At the end of swallow cycle the mandible go in centric relation. Ask the patient to swallow a little saliva and close the mouth.

FATIGUE

Centric relation is the resting horizontal position of the mandible. Whenever muscle of mastication fatigue they relax and hold the mandible in centric relation. Ask the patient to protrude and retrude the mandible repeatedly. This causes the muscles fatigue and make the centric relation record easier.

HEAD POSITION

Retrusion of the neck pull the mandible backward by the suprahyoid muscles. Ask the patient to tilt the head back, there will be tension in suprahyoid muscles, and close the mouth.



TEMPORALIS MUSCLE CHECK

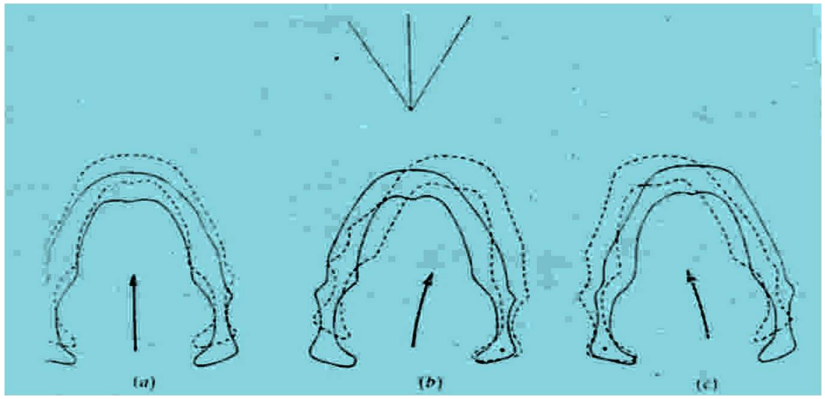
The posterior fibers of the temporalis muscle retrude the mandible and hold it in centric relation. These fibers show contraction only when clinch the mandible in centric relation.

After recording the centric relation check it by palpating the temporalis muscle and asking the patient to clinch. If the record is correct the contraction of muscle feels.

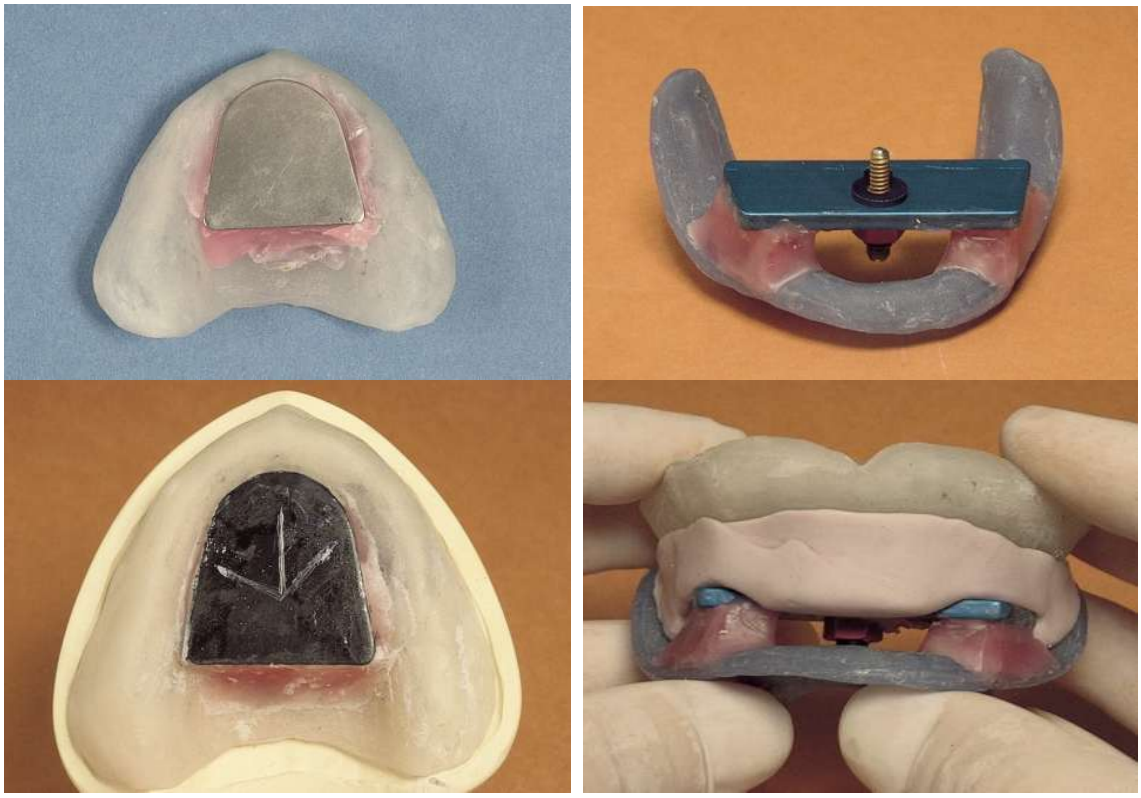
TRACING THE MOVEMENTS OF THE MANDIBLE

GOTHIC ARCH TRACING

Tracing the movement of the mandible is a mechanical graphic method to record centric relation. It is based on the theory that every movement of the mandible starts and ended at centric relation. Or the centric relation is the first and final position of the mandible in every movement.



To record the tracing intraoral and extra oral devices are available. The intraoral device is consisting of two flat thin plates. On plate has a pin in its centre called stylus other plate is flat. To record the tracing, it is required that there should be a single point of contact between the maxilla and mandible.



REQUIREMENTS OF GOTHIC ARCH TRACINGS

No contact between the bases except the Centric Bearing Plate.

The contact should be in the Middle of the lower arch.

Central Bearing Plates should be parallel.

The bases should not interfere in the lateral movements.

There should be no movements in the lower base on closure

Limitations

Tracing devices are helpful only when

The ridges are parallel to balance the mandible on a single point,

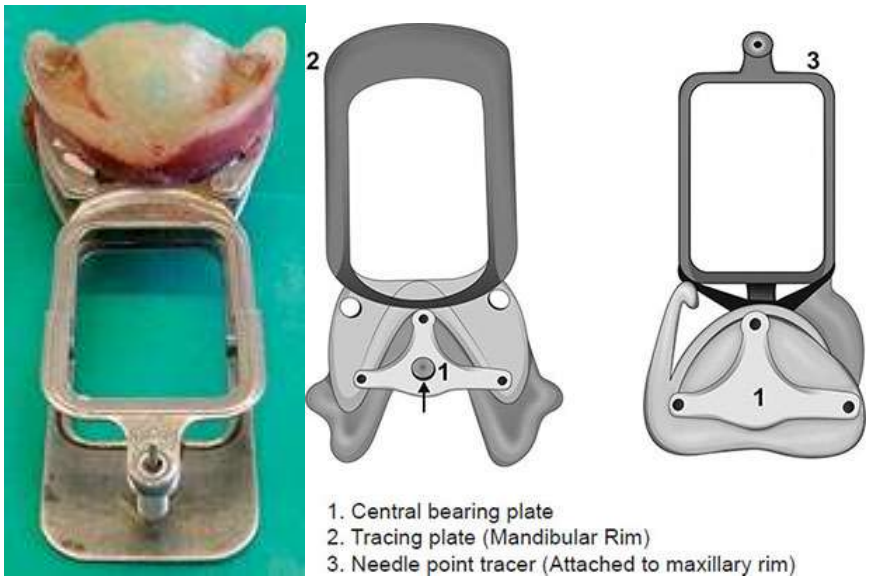
The mucosa has even thickness all around uneven mucosa distract the mandible,

There should be sufficient inter ridge space exist to accommodate the plates,

The patient should be cooperative to follow the instructions

Bases are stable so no movement occurs during mandible movements.

Tracing devices are of two types, intraoral and extraoral. The mechanism of action is same.



1. Central bearing plate
2. Tracing plate (Mandibular Rim)
3. Needle point tracer (Attached to maxillary rim)

CLINICAL ADJUSTMENT OF OCCLUSAL RIMS & THE TENTATIVE REGISTRATION OF MAXILLO-MANDIBULAR RELATIONS

ADJUSTMENT OF UPPER OCCLUSAL RIM

OBJECTIVES:

Establish the esthetic labial and buccal contours.

Establish the occlusal plane.

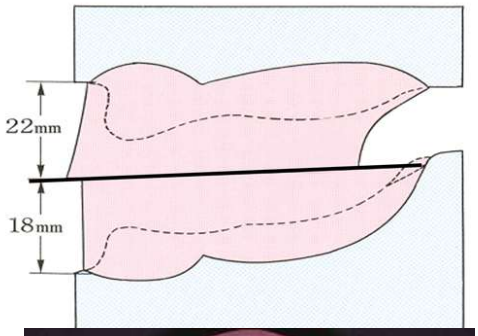
Register the vertical dimension of occlusion

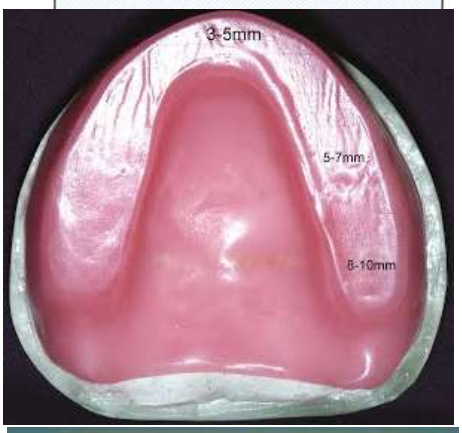
Record Orientation relation (facebow record)

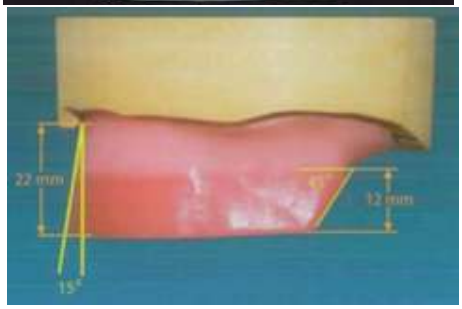
Register the centric relation.

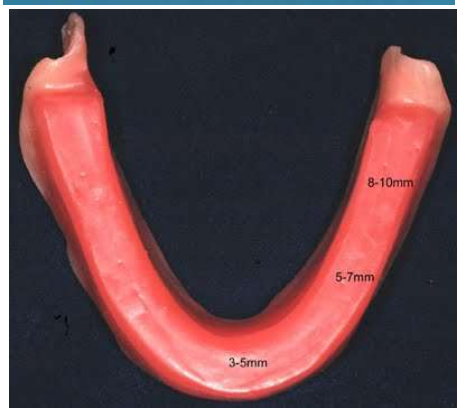
To mark the mid-line, high lip line, and cuspid to cuspid distance.

To mount the maxillary cast on the articulator, relates it to certain cranial landmarks.









INSTRUMENTS AND MATERIALS:

Alcohol torch

Fox's gauge

Flexible ruler

Inside caliper

Pooling spatula

Face bow assembly

Wax spatula

Wax knife

Baseplate wax Sticky wax

PROCEDURE

BASE PLATES CHECK UP

Check each base plate for comfort, retention and stability.

Insert the upper base plate in patient's mouth and ask for any discomfort.

Try to remove the base plate opposite to its path of insertion and note the retention.

Try to displace the plate by applying alternate forces on premolar areas in outward and upward directions and note any displacement.

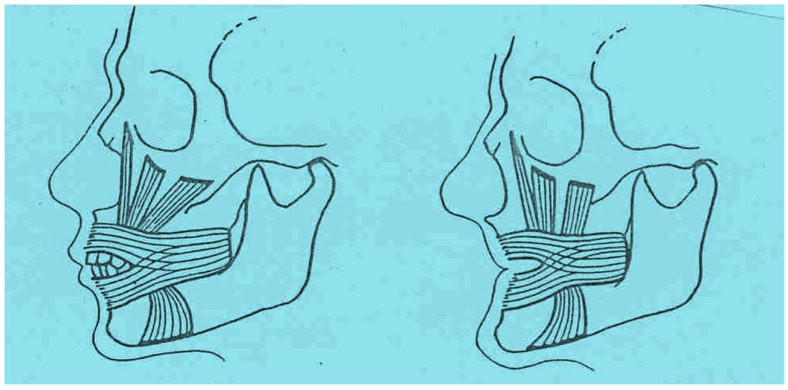
Check the post dam area up applying upward and outward force on incisors region.

Any displacement needs consultation with the supervisor.

ESTABLISHING ESTHETIC LABIAL AND BUCCAL CONTOURS:

ESTABLISHING LABIAL FULLNESS

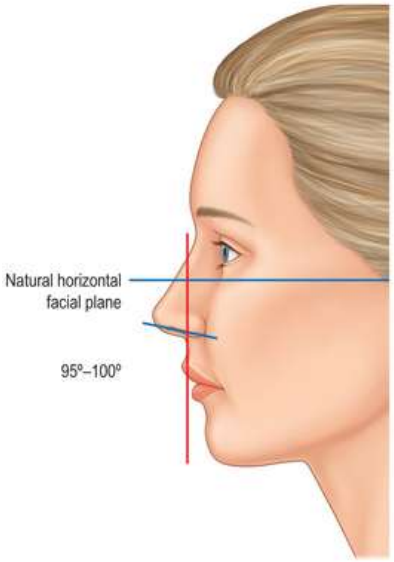
The final labial contour of the maxillary denture is established by altering that surface of the contour rim. With the maxillary contour rim in the patient's mouth, observe the facial contours from both the front and side views. If necessary, raconteur the facial surface of the rim until the desired contour is achieved. Observe the relationship of the rim to the relaxed upper lip.



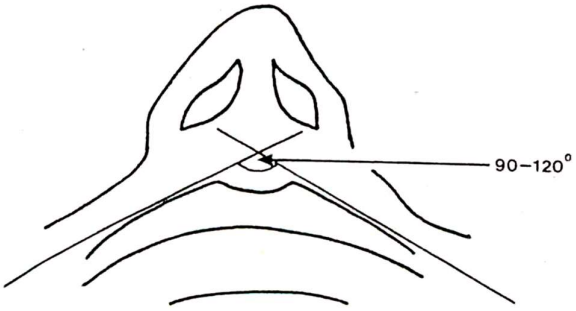
Labial fullness or labial support has two components

Naso labial angle i.e. 90 -100^0

Horizontal labial angle i.e., 90-120^0



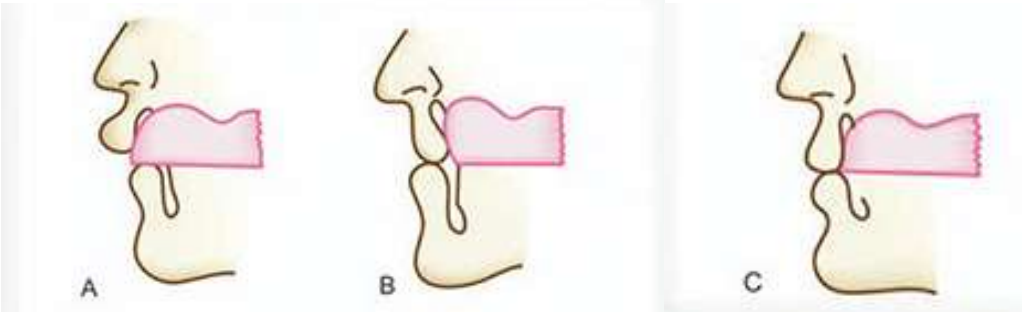
Naso- Labial Angle



Horizontal Labial Angle

Unsupported lips

Supported lips



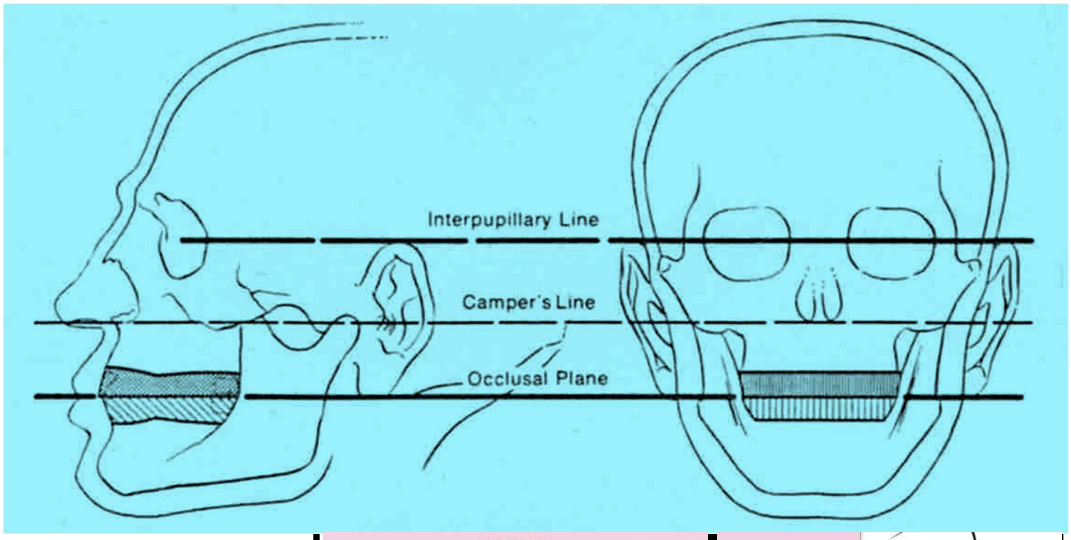
Over supported under supported normally supported

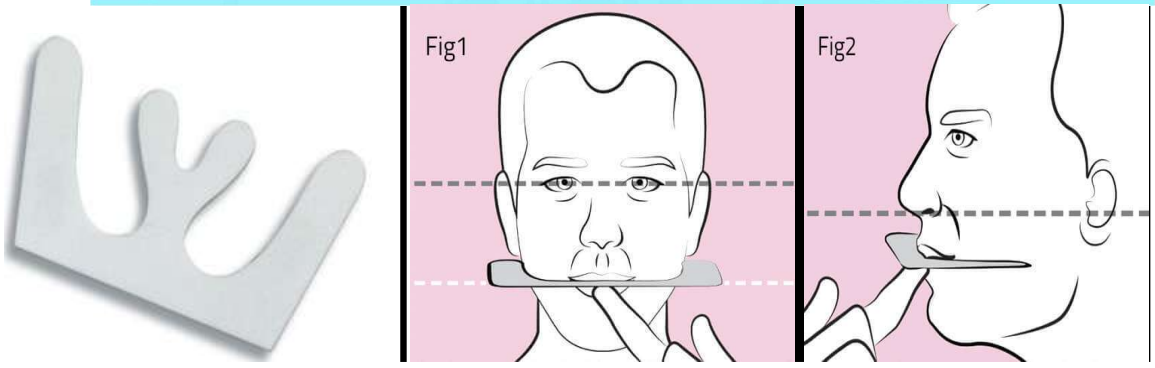
LENGTH OF UPPER WAX RIM

Normal center incisors are visible 1-2mm below the relaxed upper lip. Adjust the height of upper rim so it visible 1-2mm below relaxed upper lip. In very old patient it can be adjusted at the level of upper lip. Trim or add wax to the contour rim to achieve this relationship.

OCCLUSAL PLANE

The Occlusal Plane is established using the following guidelines:
Insert the Foxe's plane in the mouth in contact with upper rim and check the occlusal plane as follow
a) The anterior component of the occlusal plane should be parallel to a line drawn between the pupils of the eyes i.e. inter pupillary line.
b) The posterior component of the occlusal plane should be parallel to a line drawn from the ala of the nose to the mid of tragus of the ear i.e. ala-tragus line, Camphor's plane.
This can be checked with the help of Foxe's plane.





Foxe's Plane Anterior Plane Posterior Plane

MEASURING OCCLUSAL VERTICAL RELATION

There are so many methods to establish the vertical relation of occlusion. Only two are describing here.

FACIAL MEASUREMENTS METHOD

The rest vertical height can to determine by measuring the certain distances on patient face. According to Willis the following measurements are equal to the distance between the base of the ala to base of the chin.

Distance between hair line to bridge of nose (Glabella)

Distance between bridge of the nose to base of the ala

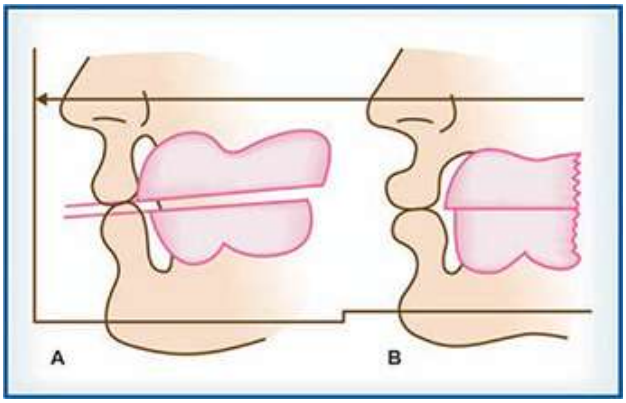
Distance between outer canthus of the eye to angle of the mouth

Measure these distances and take a mean. Now insert the both rims in patient's mouth. Measure the distance between base of the ala and base of chin. Compare this with other measurements. Adjust the distance by removing or adding wax on lower rim as required.

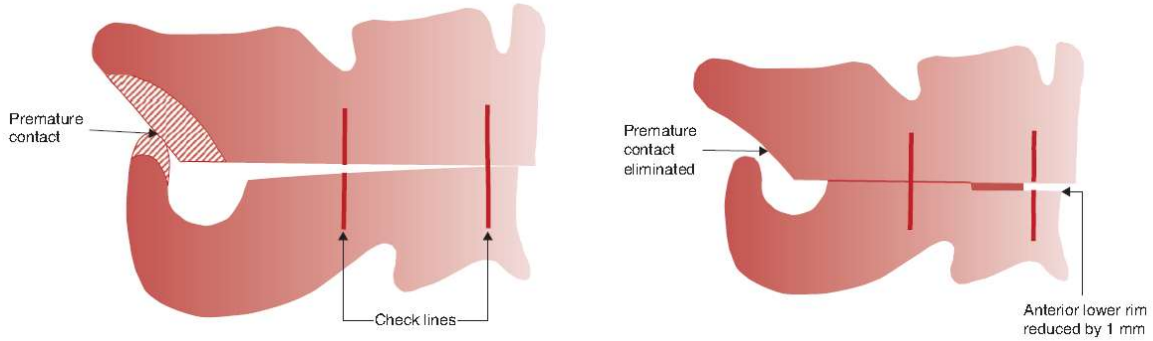
REST VERTICAL HEIGHT METHOD, NISWONGER'S METHOD,

TWO DOT METHOD

Cut two small triangles of tape and place one on the tip of the nose and the other on the chin at the midline at least movable part so that their apices face one another. Direct the patient to sit upright, free of any back or head support and relax. Insert the upper contour rim. Ask the patient to count slowly from 1 to 10. Then direct the patient to moisten the lips and swallow. Measure the distance between the apices of the tape with a ruler or a Boley's gauge. Repeat the measurement several times until a consistent result is obtained. Insert the mandibular occlusal rim and adjust its occluding surface until rest position is achieved. There should be uniform contact between the maxillary and the mandibular rims at this level.



The VDO is established by an arbitrary reduction of 2-3mm from the vertical dimension at rest relation. The rims should be in even contact all around. There should be no contact of distal parts of both acrylic base plates. Try to keep the height of both rims equal. If required the wax can be removed from the upper rim.



RECORDING CENTRIC RELATION

Remove 2mm of wax from the mandibular rim from the 1st bicuspid back on both sides and then make 2 small "V" notches. On the maxillary rim make 2 small "V" notches on both sides and lightly applied petroleum jelly. Soften Alu wax and built up on both sides of the mandibular posterior rim to a level at least 3mm higher than the occlusal plane. Insert wax rims in the patient's mouth and guide the patient's closure into Centric Relation and the Alu wax is allowed to harden. The Alu wax should completely fill the maxillary grooves. After the wax is completely hard, excess wax is trimmed away from the registration area with a sharp knife

Other method is to establish rest vertical height without removing wax for freeway space. Now soften the occlusal surface of lower wax rim 2-3mm evenly all around. Insert the rims in patient's mouth and closed in centric relation. Remove the attached wax rim on cooling of wax.

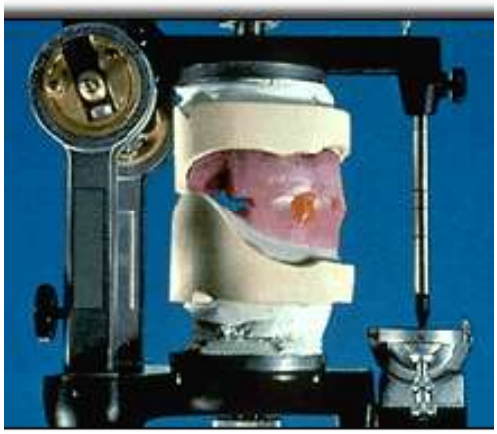
Different instruction can be giving to patient to get the centric record. As close the posterior teeth, touch the soft palate with tongue, or guide the mandible posterior by the operator.

Please Note: The procedure to record the centric relation may have to be repeated as the patient frequently resists being guided into position until he understands what is being done. It is wise to practice with the patient before the final registration is made.

ESTABLISHING THE MIDLINE, CUSPID LINE AND HIGH LIP LINE:

With the maxillary contour rim in the patient's mouth, study the face from a front view. Divide the philtrum of the lip and mark this point on the labial surface of the contour rim with a wax knife. This is the midline of the anterior segment. The distal surface of the natural maxillary canine is usually located near the corner of the mouth and a vertical line dropped from the ala of the nose to the occlusal plane will often pass through the middle of the natural maxillary canine. These landmarks will provide an estimation of the position for the artificial canines and the width of six artificial teeth on a curve. Mark these lines on both sides. Ask the

patient to smile and make a horizontal mark at the lower border of the upper lip. This is the high lip line. This mark is used to estimate the length of a maxillary central incisor.



Remove both record bases (as a unit if possible). Place the maxillary base on the maxillary cast, invert the articulator, and gently place the mandibular cast into the mandibular baseplate. Check to see that the relationship is stable, that the heels of the casts do not touch and that there is sufficient clearance for mounting plaster.

PRINCIPALS OF TOOTH SELECTION

FACTORS

1. Size
2. Form (shape)
3. Color

Size: - (Length & width)

Pre-extraction records

a. Photographs
b. Models
c. Extracted tooth
d. X-Rays

GENERAL GUIDELINES:

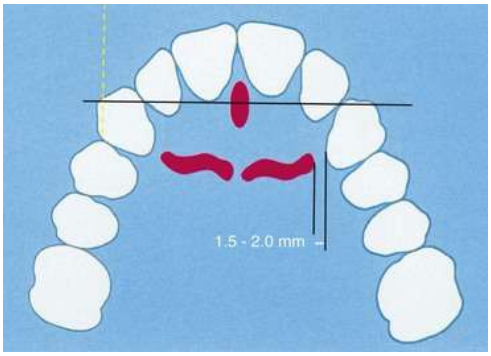
Larger person larger teeth
Women teeth smaller than same height man

Length:

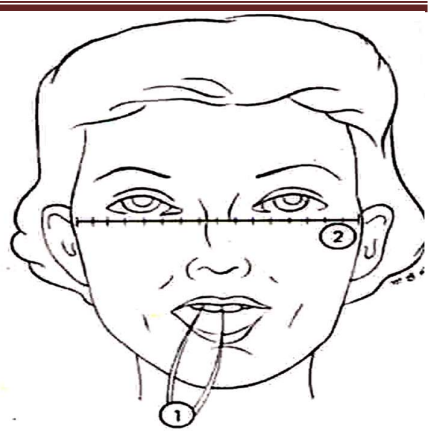
Generally, the incisal edges of natural central incisors extend 2-3 mm below the relaxed upper lip.

Width:

There are many biometric guidelines which can be used for selection of width of upper anterior teeth which are as follow

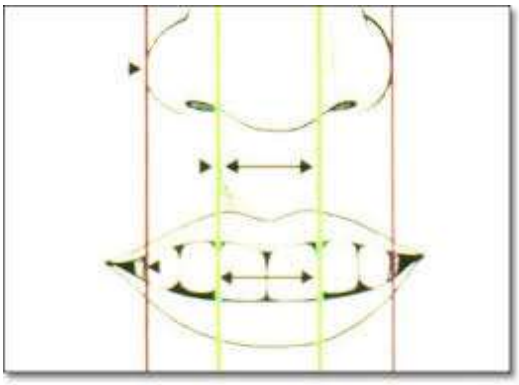


1. **Incisive Papilla**:
A line passing through the incisive papilla contacts the natural canine teeth near lips. In edentulous patient a line passing from the distal aspect of the incisive papilla may connect the lips of both canines.



2. **Bizygomatic width:**
It is suggested that if the Bizygomatic width of the face is divided by 3.3 it will be equal to the width of upper anterior six teeth. The same width is if divided by 16 it will give the width of upper central incisor.

3. **Canine Eminence:**
The distance between the distal aspects of the canine eminence on an edentulous cast, if they are well defined, is equal to the width of anterior teeth.



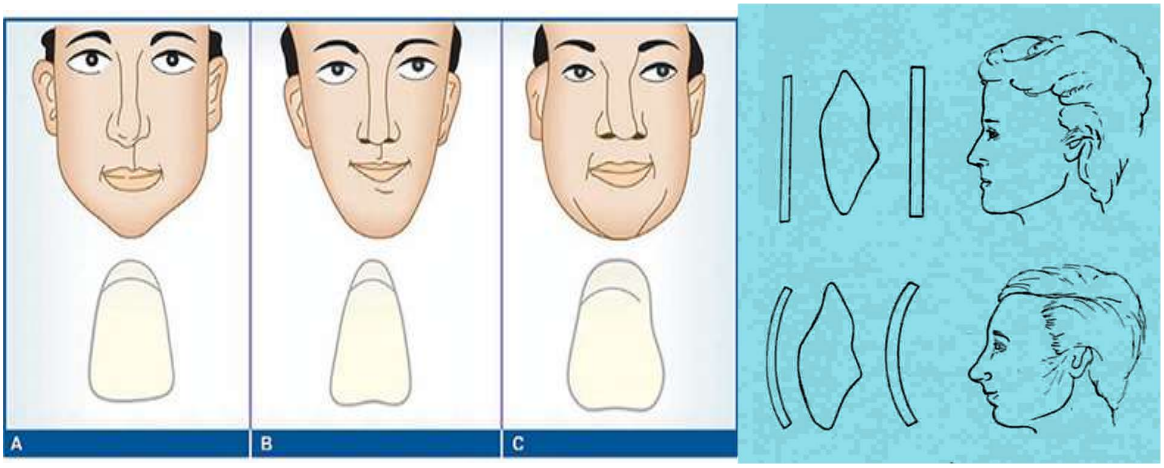
4. Cranial Circumference:
The horizontal circumference of the cranium from the glabellas to the occiput is if divided by 10 gives the width of anterior upper six teeth.

5. Comer of the mouth:
The distal surface of the natural canines is positioned at the corners of the mouth.

6. Width of the nose:
The parallel lines extended from the lateral surface of the nose will passes from the tips of the canines.

7. Lateral Surface of the nose:
A line from the center of brow, touching the lateral surface of nose will pass the distal surface of the natural canines.

Form: -
Williams's theory is that the shape of the crown of the upper central incisor corresponded to the outline from of the face. If the outline form of the central incisor is enlarged and inverted so that the incisal edge is placed in the region of the hair line, with the neck of the tooth corresponding to the outline of the chain that the form of the tooth and that of the face will coincide.
The labial surface of the teeth is also coinciding with facial profile of the patient.



ARTICULATORS

A dental articulator is an instrument to which maxillary and mandibular casts are attached to reproduces certain recorded positions of the mandible in relation to the maxilla.

The purpose of an articulation is

1. Mounting of dental casts for diagnosis, treatment planning and patient presentation
2. Fabrication of occlusal surfaces for dental restorations
3. Arrangement of artificial teeth for complete and partial dentures

CLASSIFICATION

The articulators are classified according to the transfer of records from the patient to the articulator. Those articulators, which can be adjusted by more records can, produced movements more near to patients own mandibular movement. Following records can be transferred from the patient.

Centric record

Face-bow record

A. Arbitrary Face-bow

B. Kinematic face-bow

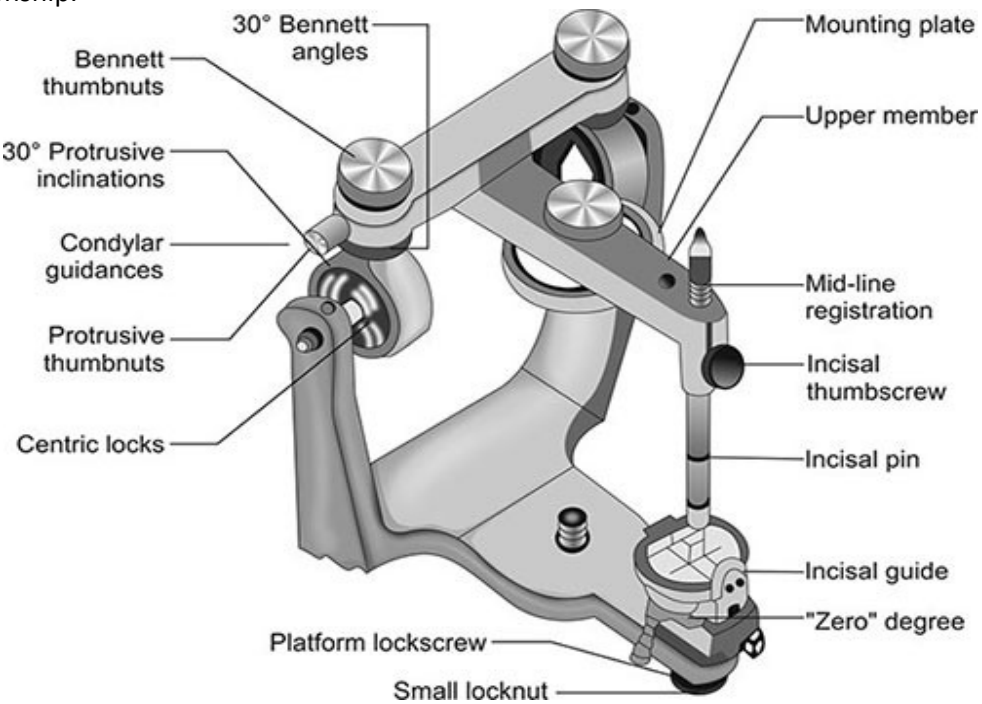
Protrusive record (i. e. Condylar angle)

Lateral record (Bennett angle)

Bennett shift

Inter condylar distance

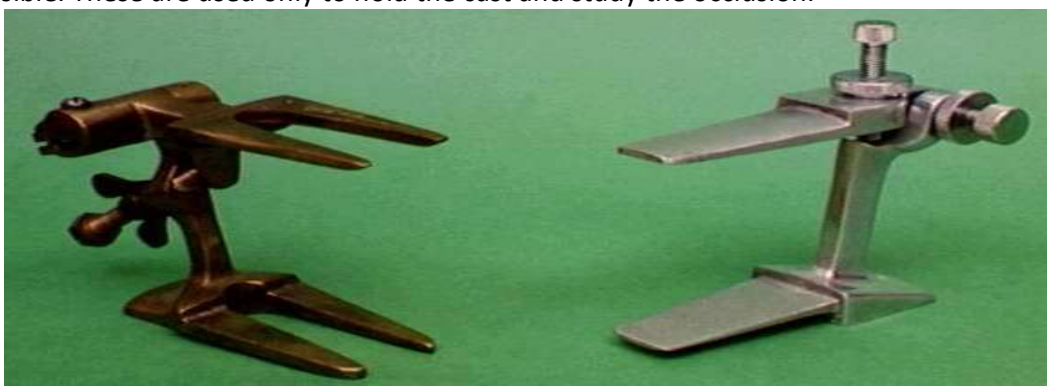
Adjustable articulators have a condyle mechanism, which can be adjusted. The articulator on which the condylar balls are attached with mandibular part and condylar fossa is attached with maxillary part is called Arcon type articulators. Non-Arcon type articulators have reverse relationship.



Parts of Articulator

CLASS I - PLAN LINE ARTICULATOR:

These are most simple articulators in which only opening and closing movements are possible. The only centric record can be transferred on these articulators and no lateral movement is possible. These are used only to hold the cast and study the occlusion.

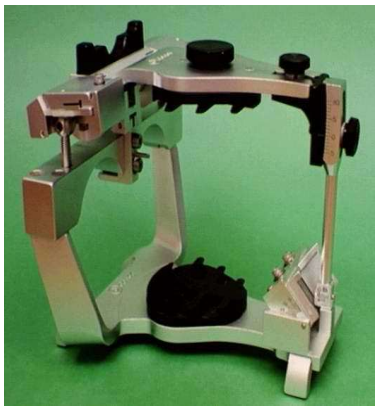


CLASS II. AVERAGE VALUE ARTICULATORS:

These articulators also accept centric record only but some eccentric movements are possible. These eccentric movements are based on the average values, which cannot be changed according to every patient. These articulators are used for small removable restorations and complete dentures.

Class I

Class II



Class III

CLASS III. SEMI ADJUSTABLE ARTICULATOR: -

These articulators can accept centric record, face-bow record (arbitrary only) and protrusive records. The lateral record i.e. Bennett Angle can be calculated by a formula i.e. L = H/8 + 12. In this formula

L = Lateral Angle (Bennett Angle)

H = Horizontal Angle (Condylar Angle)

These articulators are available in both acorn and non-acorn type models. These articulators are used for all types of removable restorations and small fixed restorations.

CLASS IV. FULLY ADJUSTABLE ARTICULATORS: -

These are most complicated and sophisticated instruments. They can accept most of the records from patients including Inter condylar distance. Kinematic face bow and Bennett angle and Bennett shift. They are available in Arcon types. They are used for fixed restorations and in complete mouth rehabilitation case with fixed restoration. They are also used for research purpose of mandibular movements and occlusion.

ARTICULATORS

ARTICULATOR	CENTRIC RELATION RECORD	FACE BOW RECORD		PROTRUSIVE RECORD (Condyle angle)	LATERAL RECORD (Bennet Angle)	INTER CONDYLAR DISTANCE
		ARBITRARY	KINEMATIC			
PLAN LINE ARTICULATOR	YES	NO	NO	NO	NO	NO
AVERAGE VALUE	YES	NO	NO	NO	NO	NO
SEMI ADJUSTABLE						
A. NON ARCON	YES	YES	NO	YES	CALCULATED L=H/8+12	NO
B. ARCON	YES	YES	NO	YES		AVERAGE S-M-L
FULLY ADJUSTABLE	YES	YES	YES	YES	YES	YES

OCCLUSION

OCCLUSION

Occlusion is defined as Static contact relationship of upper and lower teeth. The static and contact is important.

ARTICULATION

Articulation is defined as Dynamic, sliding contact relationship of upper and lower teeth. The dynamic and contact is important.

Difference between Occlusion and Articulation

OCCLUSION	ARTICULATION
Static	Dynamic
Can be recorded	Can't be recorded only reproduce
Boarder position	Inter boarder position

NATURAL OCCLUSION

Types of natural occlusion

1- Mutual Protection occlusion (canine guided occlusion)
2- Group function occlusion

MUTUAL PROTECTION OCCLUSION

Characteristics of mutual protection occlusion are

Posterior teeth in contact in centric occlusion
No anterior tooth contact in centric occlusion
In protrusive occlusion only anterior in contact
In lateral occlusion only canines in contact
No working and balancing contacts in lateral occlusion

Centric contacts lateral movement canine contact

Protrusive contacts working side contacts

GROUP FUNCTION OCCLUSION

Characteristics of group function occlusion are

1. In lateral occlusion all or at least 2 teeth come in contact with other then canine on working side

2. No anterior contact in centric occlusion

3. No balancing side contacts

This type of occlusion is recommended where
Canines are weak
Canine is a Pontic
In old age due to attrition

Group function occlusion

BALANCED OCCLUSION

The maximum number of teeth contact occurs all around the dental arch in all closed static positions, only for artificial occlusion. Natural occlusion can never be balance.

BALANCE ARTICULATION

The maximum number of contact of teeth should be maintained all around dental arch in all closed sliding movements.
In natural occlusion teeth contacts occurs only on working side. In natural occlusion there is space created in protrusive occlusion that is called Christensen's phenomenon. The objective of balance occlusion is complete dentures is to eliminate this Christensen's phenomenon which is the destabilizing factor for dentures.

OBJECTIVES OF COMPLETE DENTURE OCCLUSION

Stability (three-point contact)
The minimum one contact should occur on anterior teeth, one on right and one on left side in protrusive occlusion. The minimum of one contact should occur on working side and two on balancing side.

1. Jaw movements without cusp interference.
2. Maximum cusp contact
3. Decreasing masticatory load to bone per unit area

PROBLEMS OF UNBALANCED OCCLUSION

TILTING OF DENTURES
Contact of teeth on one side of dentures causes dropping of the denture from other side of arch.
CUSP INTERFERENCE
Cusp interference during jaw movements destabilized the dentures
REDUCED EFFICIENCY
Limitations of jaw movements causes reduced mastication.
PAIN TRAUMA
Concentration of forces on one point due to high cusp contact causes pain and trauma to soft and hard tissues.

ADVANTAGES OF BALANCE OCCLUSION
STABILITY
Tooth contact on both side of the arch prevents the dropping of denture and improves the stability.
REDUCED TRAUMA
Even contacts of the teeth on both sides distributes the masticatory load on all over the arch and reduces the load per unit of bone by this reduces the trauma and bone resorption.
FUNCTIONAL MOVEMENTS
It creates more functional movements without any cuspal interference.

IMPROVED EFFICIENCY

It improves mastication by allowing lateral movements without cuspal interference. Balanced occlusion can be achieved by creating a harmonious relationship between the condylar path and all other factors of occlusion.

REQUIREMENTS FOR BALANCED OCCLUSION

1- Adjustable Articulator
2- Jaw relation record
   Face bow
   Protrusive record
   Lateral record
3- Understanding of Factors of Occlusion

ADJUSTABLE ARTICULATOR

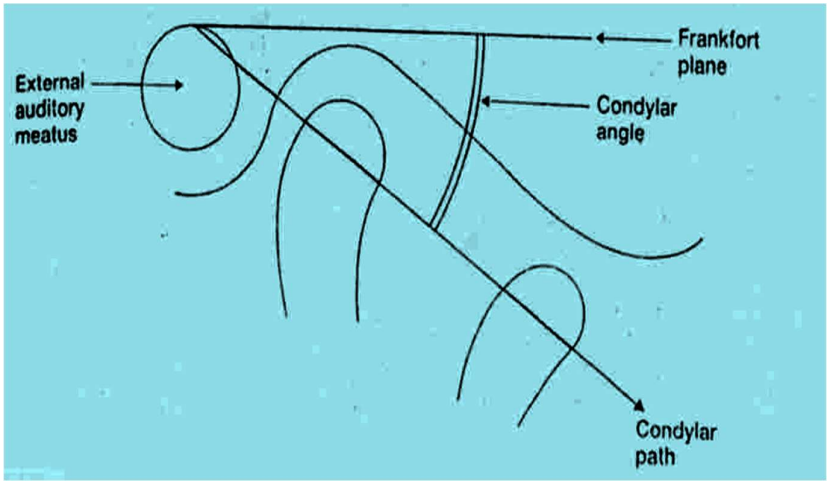
It should accept the face bow record and its condylar apparatus should be adjusted by protrusive and lateral occlusal record of patients.

FACTORS OF OCCLUSION

1. Condylar Guidance
2. Incisal Guidance
3. Orientation of Occlusal Plane
4. Orientation of Compensating Curves
5. Cusp Angle

CONDYLAR GUIDANCE

When mandible moves in a protrusive occlusion, the condyles move forward and downward on the distal slopes of the articular eminence. The angle which this path makes to the horizontal is condylar guidance angle. The path of the condyle is called sagittal condylar path.



The condylar path and angle both combine and form Condylar Guidance. Condylar Guidance is depending upon the Anatomy of Joint. It is the only factor recorded from the patient. It is recorded by the protrusive occlusal records. The condylar apparatus of the articulator is adjusted by these records.

INCISAL GUIDANCE

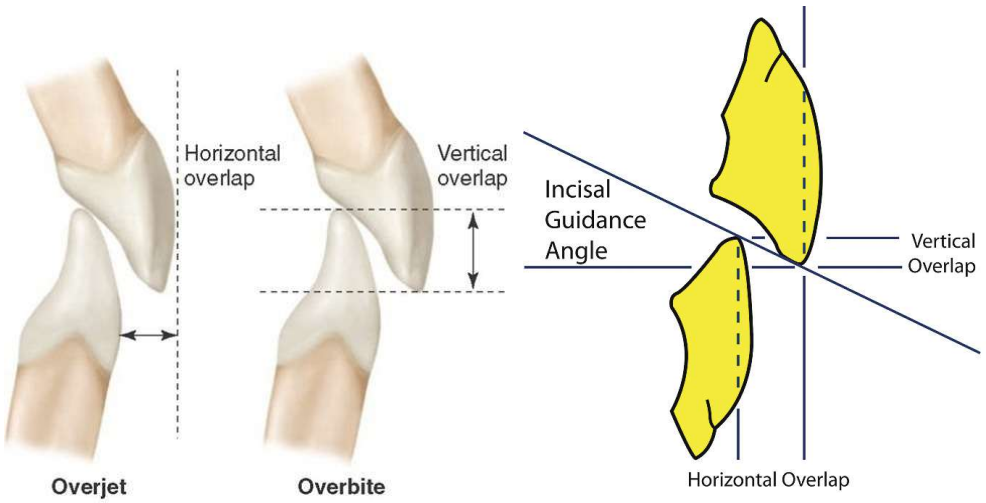
When the mandible moves in protrusive occlusion, the lower incisors move downward and forward to an edge-to-edge occlusion. The path along which the lower incisors move make an angle to the horizontal called the incisal guidance angle and this movement is called incisal guidance. Incisal guidance depends upon the horizontal and vertical overlap of incisors and determined by the Esthetics.

OVER JET

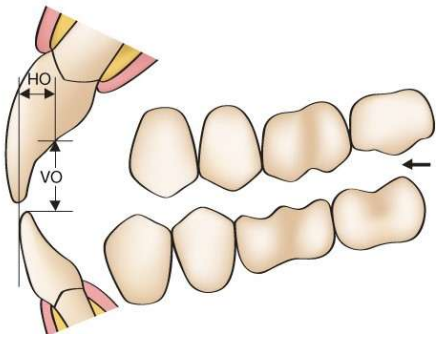
It is the distance between the labial surface of the lower central incisor and midpoint of the edge of upper central incisor in centric occlusion. It is also called horizontal overlap.

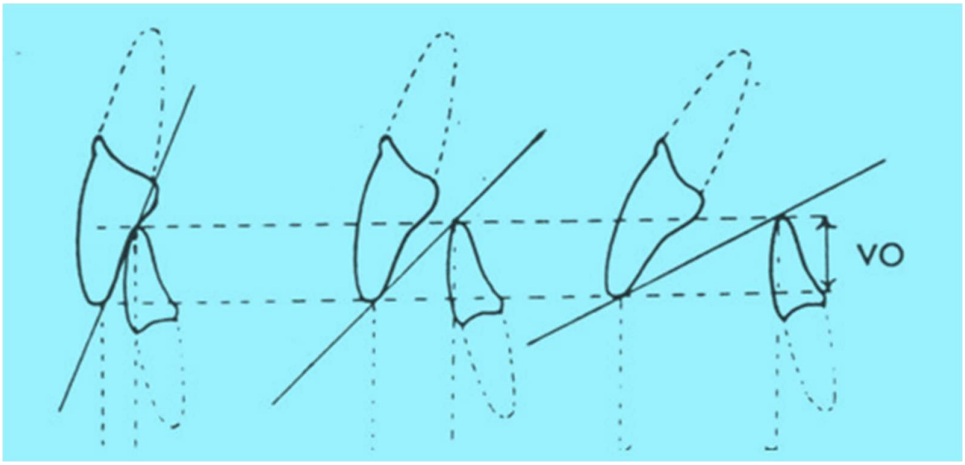
OVER BITE

It is the distance between the incisal edges of the maxillary central incisor and mandibular central incisor in centric occlusion. It is also called vertical overlap.



In balance occlusion always try to reduce incisal guidance angle.
Increased incisal guidance angle creates large space between posterior teeth during protrusive and lateral movements (Christensen's Phenomenon) and reduce the stability. Increased overbite and decreased over jet create increased incisal guidance angle. As in Angles class II occlusion. This creates a large space between the posterior teeth. This space causes the dropping of denture due to unbalance occlusion.
This can be solved by reducing Incisal guidance.
Reducing Incisal guidance angle is possible by
Reducing the over bite
When it is not possible due to esthetics than
Increasing over jet





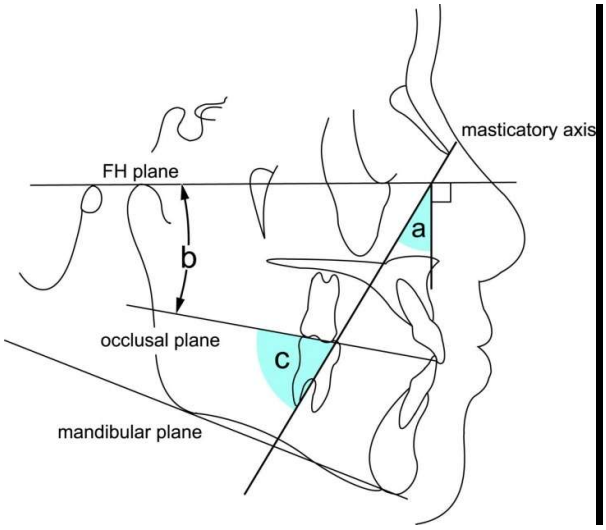
ORIENTATION OF OCCLUSAL PLANE

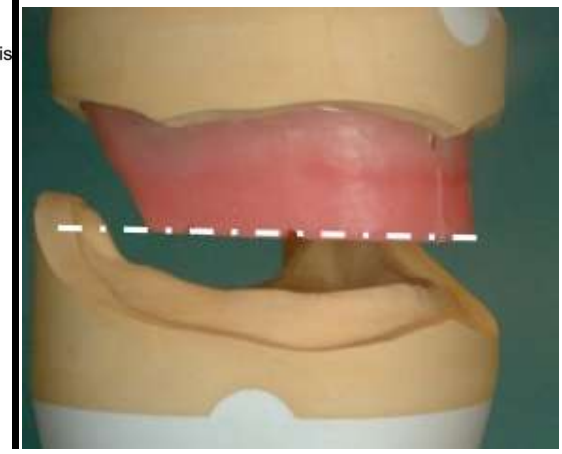
OCCLUSAL PLANE

It is an imaginary plane. It touches the incisal edges of the mandibular central incisors and the tips of the distobuccal cusps of the second mandibular molars.

OCCLUSAL PLANE ANGLE

Angle between occlusal plane and horizontal (Frankfort plane) is called angle of occlusal plane.
The orientation of occlusal plane is done by
Anterior by Esthetics i.e., corners of mouth.
Posterior it should be at the level of junction of Anterior 2/3 with posterior 1/3 of retro molar pad





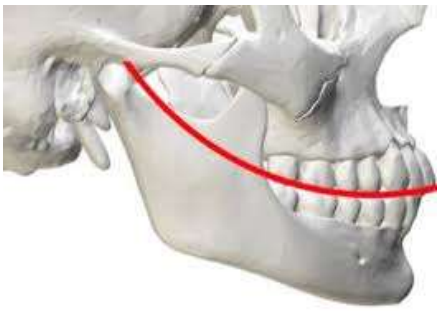
COMPENSATING CURVES

Anterior -posterior Compensating Curve (Curve of Spee)
Lateral Compensating Curve (Curve of Wilson)

ANTERIO -POSTERIOR COMPENSATING CURVE (CURVE OF SPEE)

It is an imaginary curve. It passes from the lower incisors to the buccal cusp's tips of the mandibular posterior teeth in natural occlusion.

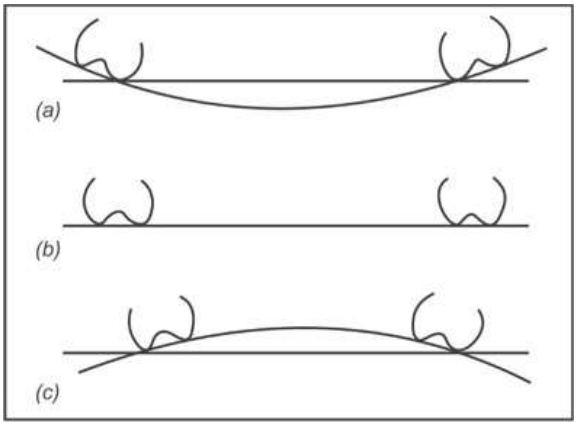
In artificial occlusion it is called anterior posterior compensating curve and produced in maxillary teeth.



LATERAL COMPENSATING CURVE (CURVE OF WILLSON)

It is a lateral curve. Its convexity facing upward in molars(a), it becomes straight in 2nd premolars(b) and convex in 1st premolars(c).

In complete denture occlusion it is called lateral compensating curve. It is a bucco- palatal palato-buccal curve. In artificial occlusion it refers to maxillary teeth. In natural occlusion it is seen in mandible and called curve of Wilson.



FUNCTION OF CURVES

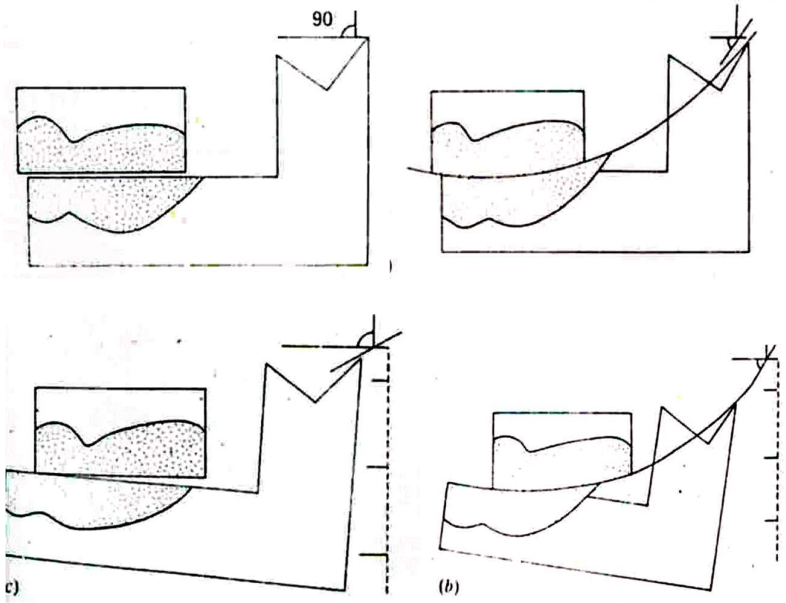
Compensating curves allows the freedom of movements of the mandible.

They create sliding movements free of cuspal interferences.

They keep the teeth in contact in balance occlusion.

They compensate the space created b/t posterior teeth during forward and lateral movements of mandible; because of this they called compensating curves.

In natural occlusion the curves are shallow but in balance occlusion curves are deep.

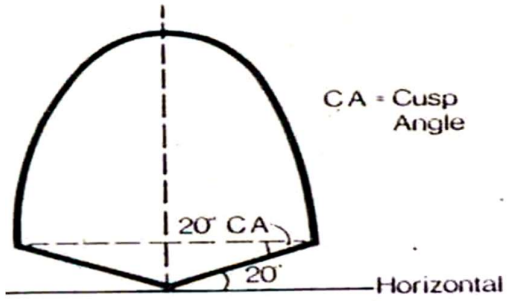


CURVE OF MONSON

Extending the curve of Spee and Wilson to all cusps and incisal edges reveals the curve of Monson. It is only presenting in natural occlusion

CUSP ANGLE

If a horizontal plan is passing through the base of the cusp of a tooth, the angle of the cusp slope with the horizontal plane is called cusp angle.

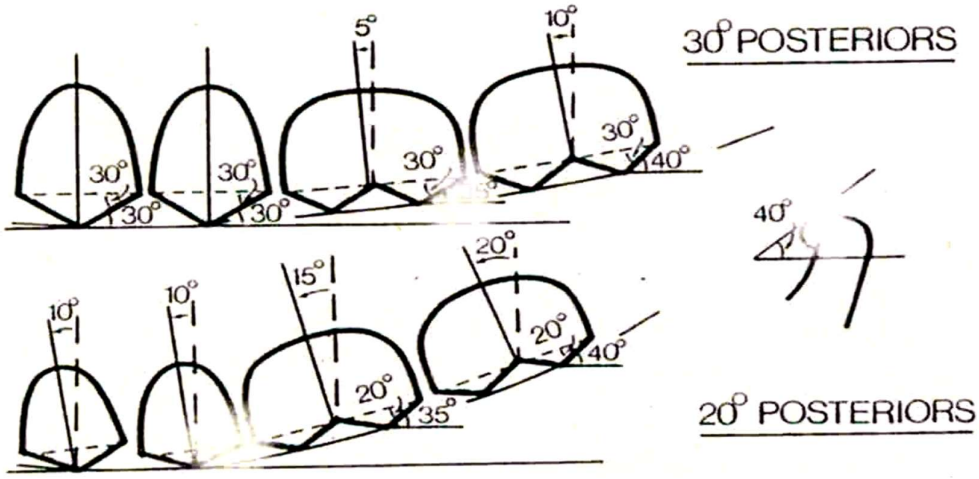


EFFECTIVE CUSP ANGLE

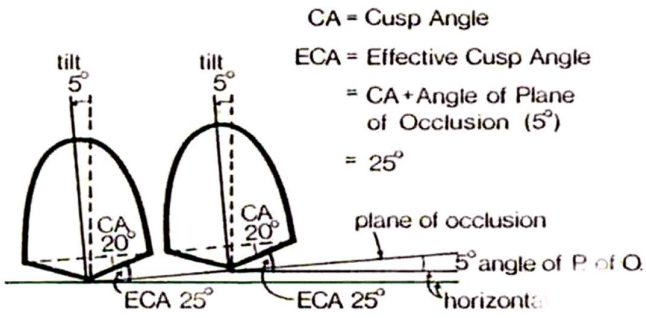
The angle of the cusp and the angle of the occlusal plane when added is called effective cusp angle.

By the help of this we can increase or decrease the cusp angle of the same tooth. By tilting the same cusp posteriorly increases the angle of the cusp and tilting anteriorly reduces the cusp angle. Now these angles are called effective cusp angles.

Changing Cusp Angle

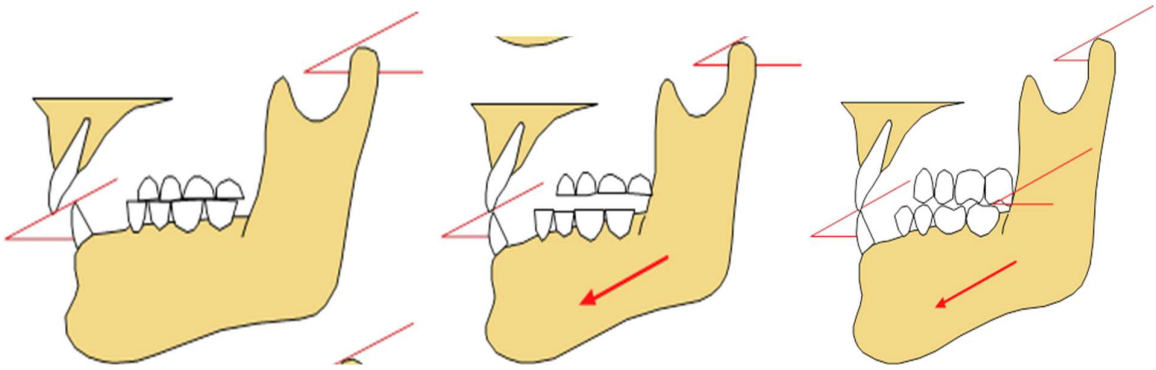


Effect of cusp angle



When the mandible moves forward in protrusive a space is created in posterior teeth this space can be filled by increasing the cusp angle.

But increasing the cusp angle, more than 20 degrees, has its own limitations. It needs large inter arch space. It generates large displacing forces in lateral movements and destabilizes the dentures. Large cusp teeth are not recommended in very old patients and poor ridge heights.



FACTS ABOUT BALANCE OCCLUSIO

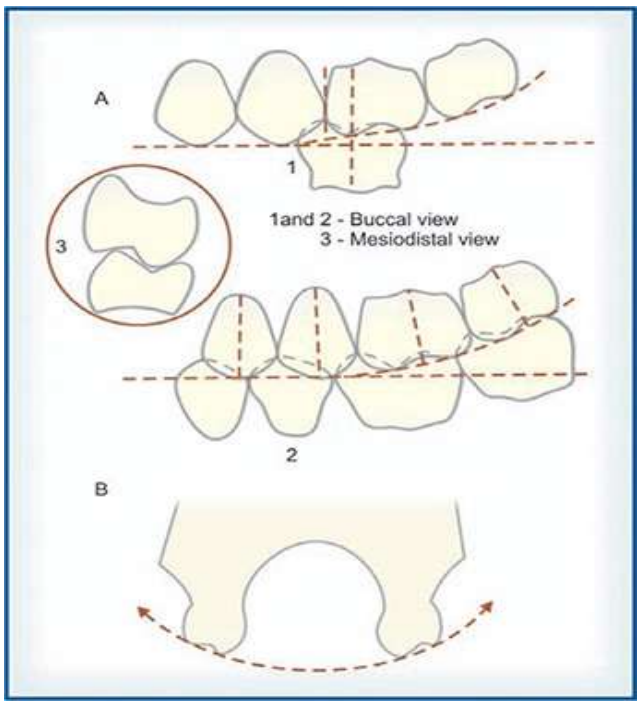
The condylar guidance angle at posterior end and incisal guidance at anterior end controls the mandible movements. The movement is forward and downward direction. This movement creates space between posterior teeth. This space is normal and desirable in natural occlusion. But in complete denture occlusion it destabilizes the dentures. The objective of balance occlusion is to eliminate this space by making occlusal contacts of posterior teeth and allow mandible a smooth sliding movement. The size of the space depends upon the condylar guidance angle and incisal guidance angle (over jet & overbite). It can eliminate by

1- Reducing incisal guidance angle, if possible, by reducing over bite.
When it is not possible due to esthetics than by Increasing over jet

2- By increasing the cusp heights
But it generates large lateral stresses on the dentures and reduces the stability.

3- By deepening the compensating curves
It requires the increase inter arch space. It pushes the lower denture forward and upper backward

4- It can be achieved by increasing the effective cusp angles which is most effective and suitable method. It is combination of cusp angle and compensating curves and angle of the occlusal plane.



TYPES OF BALANCE OCCLUSION

Monoplane occlusion
Lingualized occlusion

MONOPLANE OCCLUSION

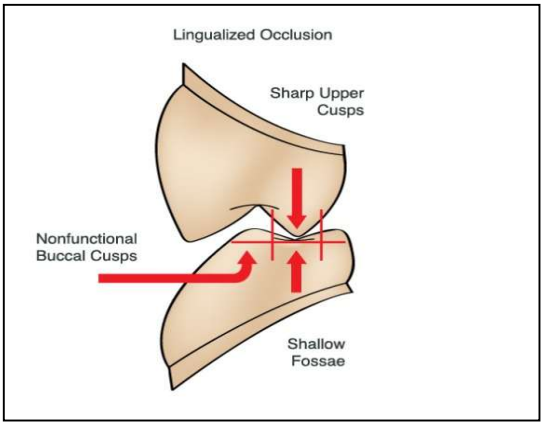
In this type of occlusion the zero-degree cusp teeth are used.

Indications

It is used in patients with
Muscles dyskinesia
Parkinsonism
Resorb ridges
Difficult to record centric relation (Angle's class II)

This type of occlusion has the crushing action of mastication which may transfer more forces on the ridges. A posterior stop is provided for denture stability.

LINGUALIZED OCCLUSION



In this occlusion the only upper lingual cusps contact in central fosse of lower teeth in all occlusal contacts.

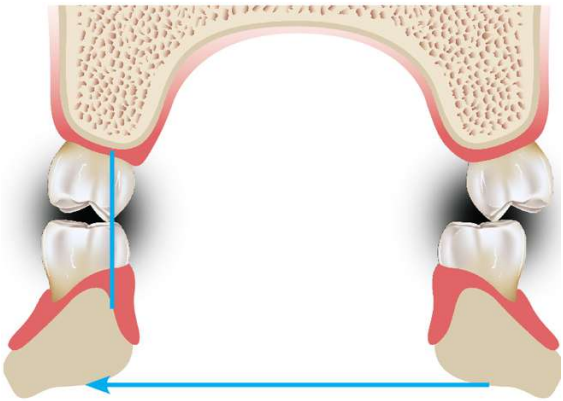
ADVANTAGES

Improve stability
Reduce occlusal contact
Reduce load to ridges
Cutting action improve mastication

OTHER RELATED OCCLUSAL DEFINITIONS

SUPPORTING CUSPS AND GUIDING CUSPS

Those cups which make contact with central fossa of opposing tooth are called supporting cups. The palatal cusp of maxillary teeth and buccal cusps of mandible teeth are supporting cusps. Other cups are called guiding cups because they guide the mandible during movements.



Working side *Balancing side*

GUIDING INCLINES

The inner occlusal inclines of the guiding cusps are called guiding inclines.

WORKING SIDE

That side towards which mandible is moving is called working side.

BALANCING SIDE

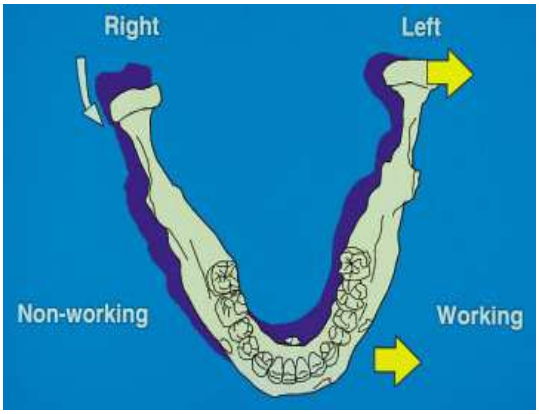
That side from which mandible is moving is called balancing side.

WORKING SIDE CUSPS RELATION

Buccal cups of upper and lower teeth come in line with each other.

BALANCING SIDE CUSPS RELATION

Palatal cups of upper teeth come in line with buccal cups of lower teeth

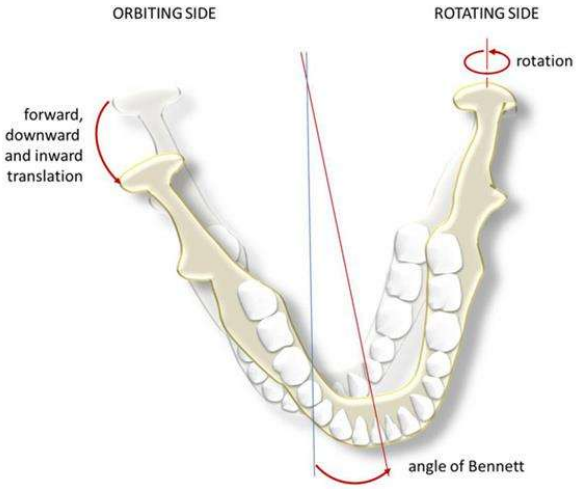


BENNETT MOVEMENTS OF THE CONDYLES

Working and balancing side movements of condyles are called Bennett movements.
Working side movements is called Bennett's Shift
Balancing side movement is called Bennett's Angle

BENNETT SHIFT

When mandible moves the working side, condyle move in lateral direction not more than 1mm this lateral shift of condyle is called Bennett shift.



BENNETT ANGLE

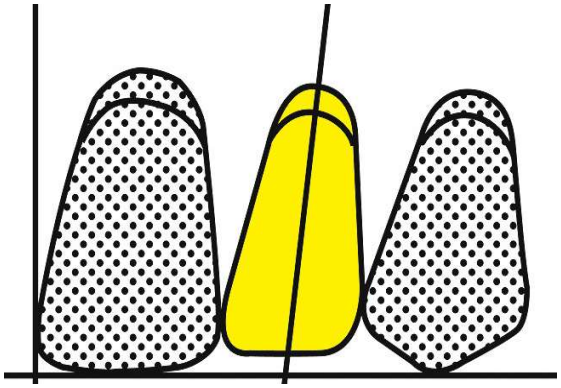
To compensate the working side condyle movement, the balancing side condyle moves forward, downward and medially. The angle between this position of condyle and sagittal plane is called Bennett angle.
The Bennett angle and shift can be recorded from the patient with the help of lateral occlusal records.

SETUP OF TEETH

Relationship:

There are five relations according to which every single tooth is set. These are

1. Mesiodistal
2. Labiolingual (Labio palatal, Buccolingual, Bucco palatal)
3. Occlusal Plane
4. Ridge Relation
5. Arch Relation



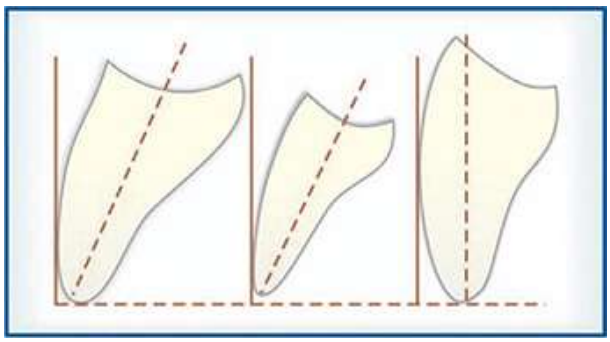
Maxillary Setup:

Central Incisor

1. Vertical
2. Labial (15°)
3. Incisal edge contact occlusal plane
4. 3-4 mm overlaps the alveolar ridge
5. Follow the arch contour

Lateral Incisor:

1. Mesialy inclined
2. More labial than central incisor
3. Incisal edge 1-2mm higher than occlusal plane
4. 3-4 mm overlaps the alveolar ridge
5. Follow the arch from

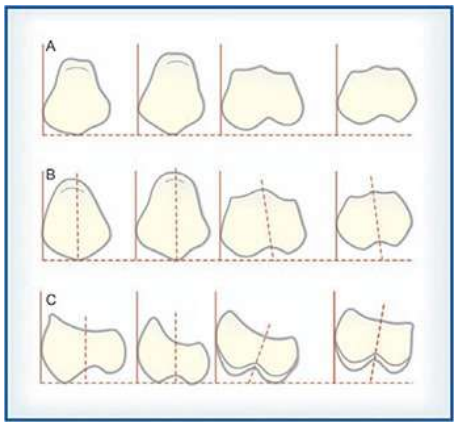


Canine:

1. Vertical may be mesial but never distal
2. Tip is slightly lingual neck is labial
3. Tip contact the occlusal plane
4. 3-4 mm overlap the alveolar ridge
5. Follow the arch form

1st Premolar:

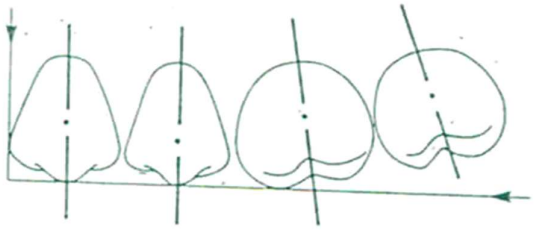
1. Vertical
2. Vertical
3. Buccal cusp touches the occlusal plane, palatal cusp l mm higher than the occlusal Plane.
4. Central fissure is on the center of the ridge
5. Follow the arch form



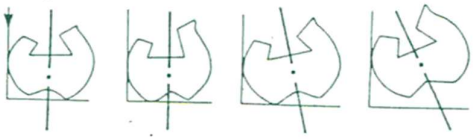
2nd Premolar:

1. Vertical.
2. Vertical.
3. Both cusps touch the occlusal plane.
4. Central fissure on the center of the ridge.
5. Follow the arch form.

1st molar:



1. Distally inclined.
2. Buccally inclined.
3. Mesiopalatal cusp touches the occlusal plane; the buccal cusps are 1 mm higher while distal cusps are1.5mm higher than the occlusal plane. Its mesiobuccal cusps occlude in buccal fissure of the lower 1st molar. Its mesiopalatal cusp occludes in the central fossa of the lower first molar. Its distopalatal cusp occludes into the distal marginal ridge of lower 1st molar and mesial marginal ridge of the lower 2nd molar. Its distobuccal cusp occludes into the embrasure between 1st and 2nd lower molar.

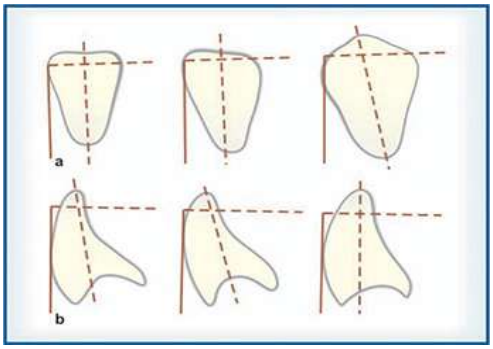


2nd molar:

1. More distal than 1st molar
2. More buccal than 1st molar
3. Mesio palatal cusp is nearest to the occlusal plane but not touches it, other cusps are higher than 1st molar. Its mesiopalatal cusp occlude in central fossa of lower 2nd molar.
4. Central fissure is on the center of the ridge
5. Follow the arch form

Note: - **All the upper posterior teeth should not be buccal to the upper canine.**

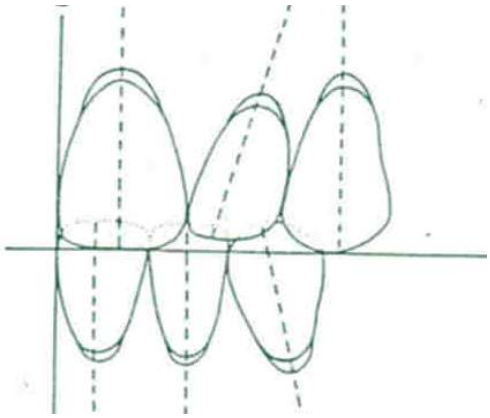
Mandible Setup



Central incisor:

1. Vertical
2. Labially inclined
3. Incisal edge is 2mm above the occlusal plane
4. 3-4 mm overlap the alveolar ridge
5. Follow the arch form

Lateral incisor:



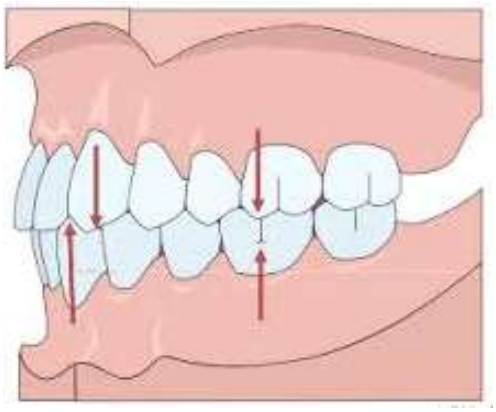
1. Vertical
2. Less labial than central incisor
3. Incisal edge is 2mm above the occlusal plane
4. 3-4 mm overlap the alveolar ridge
5. Follow the arch form

Canine:

1. Mesialy inclined.
2. Tip is lingually inclined slightly.
3. Tip is 2mm higher than occlusal plane.
4. 3-4mm overlap the alveolar ridge.
5. Follow the arch form.

Note: The distal line angle of the lower canine should never be distal to the tip of upper canine.

The tip of upper canine and distal boarder of lower canine should be in one line.

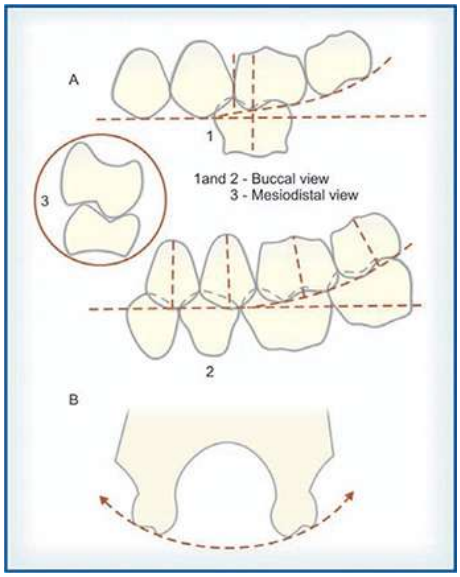


1st Premolar:

1. Vertical
2. Vertical
3. Its buccal cusp is higher the occlusal plane and make contact with mesial marginal ridge of the upper 1st pre molar
4. Its fissure is on the center of the ridge
5. Follow the arch form

2nd premolar:

1. Vertical.
2. Vertical.
3. Both cusps are higher than the occlusal plane and make contact with the distal marginal ridge of the 1st upper premolar and mesial marginal ridge of the 2nd upper premolar.
4. Central fissure is on the center of ridge
5. Follow the arch form



1st Molar:

1. Mesial inclined
2. Lingually inclined
3. All cusps are higher than occlusal plane. Its mesio buccal cusp occludes into the distal marginal ridge of the upper 2nd premolar and mesial marginal ridge of the upper 1st molar. Its distobuccal cusp occludes into the central fossa of the upper 1st molar.
4. Central fissure is on the center of ridge.
5. Follow the arch from.

2nd Molar:

1. More mesial than 1st molar.
2. More lingual than 1st molar.
3. All cusps are higher than 1st molar. The mesiobuccal cusp makes contact with the distal marginal ridge of 1st upper molar and mesial marginal ridge of the 2nd upper molar.
4. Central fissure is on the center of ridge.
5. Follow the arch form.

ANTERIOR SETUP

TOOTH	MESIO-DISTAL	LABIO-LINGUAL	OCCLUSAL PLANE	RIDGE RELATION	ARCH RELATION
Max. Central Incisor	Vertical	Labial (15°)	Incisal edge contacts occlusal plane	3-4 mm overlaps the alveolar ridge	Follow the arch form
Max. Lateral Incisor	Mesial inclined	More labial than central incisor	Incisal edge 1-2mm higher than occlusal plane	3-4 mm overlaps the alveolar ridge	Follow the arch from
Max. Canine	Vertical may be mesial but never distal	Tip is slightly lingual neck is labial	Tip contact the occlusal plane	3-4 mm overlap the alveolar ridge	Follow the arch form
Man. Central Incisor	Vertical	Labial inclined	Incisal edge is 2mm above the occlusal plane	3-4 mm overlap the alveolar ridge	Follow the arch form
Man. Lateral Incisor	Vertical	Less labial than central incisor	Incisal edge is 2mm above the occlusal plane	3-4 mm overlap the alveolar ridge	Follow the arch form
Man. Canine	Mesial inclined	Tip is lingual inclined slightly	Tip is 2mm higher than occlusal plane	3-4 mm overlap the alveolar ridge	Follow the arch form

The distal line angle of the lower canine should never be distal to the tip of upper canine. The tip of upper canine and distal boarder of lower canine should be in one line. All upper anterior teeth should, 3-4mm, overlap lower teeth to make over jet and overbite.

POSTERIOR SETUP

TOOTH	MESIO-DISTAL	LABIO-LINGUAL	OCCLUSAL PLANE	RIDGE RELATION	ARCH RELATION
Max. 1st Premolar	Vertical	Vertical	B. cusp touches the OP, P cusp 1mm higher than OP	Central fissure is on the center of the ridge	Follow the arch form
Max.2nd Premolar	Vertical	Vertical	Both cusps touch the occlusal plane	Central fissure is on the center of the ridge	Follow the arch from
Max. 1st Molar	Distally inclined	Buccally inclined	MP cusp touches OP, B cusps are 1 mm higher. D. cusps 1.5mm higher, MB cusps occlude in buccal fissure of the lower 1st molar	Central fissure is on the center of the ridge	Follow the arch form
Max. 2nd Molar	More distal than 1st molar	More buccal than 1st molar	MP cusp is nearest to OP but not touches it; other cusps are higher than 1st molar. MP cusp occludes in central fossa of lower 2nd molar	Central fissure is on the center of the ridge	Follow the arch form
All the upper posterior teeth should not be buccal to the upper canine. Upper posterior teeth should be placed in a manner that when viewed from front their buccal surfaces hide behind the canine.					
Man. 1st. Premolar	Vertical	Vertical	B cusp is higher the OP and make contact with MMR of the upper 1st pre molar	Central fissure is on the center of ridge	Follow the arch form
Man. 2st. Premolar	Vertical	Vertical	Both cusps are higher than OP and make contact with the DM ridge of the 1st upper premolar and MM ridge of the 2nd upper premolar	Central fissure is on the center of ridge	Follow the arch form
Man. 1st. Molar	Mesial inclined	Lingual inclined	All cusps are higher than OP. MB cusp occludes into the DMR of the upper 2nd premolar and MMR of upper 1st molar. Its DB cusp occludes into the central fossa of the upper 1st molar.	Central fissure is on the center of ridge	Follow the arch from.
Man. 2st. Molar	More mesial than 1st molar	More lingual than 1st molar	All cusps are higher than 1st molar. MB cusp makes contact with the DMR of 1st upper molar and MMR of the 2nd upper molar	Central fissure is on the center of the ridge	Follow the arch from
B= buccal, P= palatal DMR= distal margin ridge, MMR= mesial margin ridge, OP occlusal plane,					

TRIAL OF COMPLETE DENTURE

After completing the setup of teeth, it is necessary to trial the dentures in patient's mouth before final processing. Any changes require can easily be done in waxed dentures. It is recommended to follow the same order of checking as the order of procedures performed. Following is the list of checkups should be done.
Make sure the trial denture base plate should have a clean and free of extra wax surface.
Peripheral outline of upper and lower dentures should to check for over and under extensions. Start from labial side to buccal, distal, and lingual on both sides for lower and post dam area for upper.

Stability and Retention

Height of occlusal plane

Tongue space

Vertical Dimension of occlusion

Centric Relation

Evenness of occlusal contacts

Appearance

Mid line

Anterior occlusal plane

Shape of teeth

Size of teeth

Shad of teeth

Profile and lip form

Amount of tooth visible

Normal speech

Approval by the patient

DENTURE INSERTION

DEFINITION:
The process of delivering finished dentures with instructions for use to the patient**.**

INSTRUMENTS AND MATERIALS

1. Mouth mirror
2. Articulating paper
3. Pressure indicating paste
4. Acrylic burs

PROCEDURE

Examine dentures mounted on articulator
Inspect the complete dentures before inserting them in the patient's mouth. First check the dentures mounted on the articulator for uniform occlusal contacts in centric relation. If teeth were set in balanced occlusion verify simultaneous bilateral contact on eccentric movements. Confirm that the OVD is maintained and Incisal pin is touching the Incisal table. Remove any pre maturities with the help of articulating paper and burs.

Examine denture bases
Finish and polish of the dentures, they should be smooth to touch and mirror like in finish. Check the inner/tissue surface with fingertip to make sure that there are no imperfections voids, acrylic pearls or ridges which can hurt or irritate the oral mucosa. Denture flanges should be smooth and rounded with no sharp angles or knife edges, the frenal relief area should also be rounded and smooth.
When satisfied with finish try the upper and lower dentures in the patient's mouth one by one. And check the following,

Examine maxillary denture

Comfort
Insert the maxillary denture, check adaptation of base plate and ask the patient about comfort of the denture. If there is any discomfort identify the offending area with the help of a pressure indicating paste or indelible pencil and adjust accordingly. Check the distal border for close adaptation with the palatal tissue with help of mouth mirror.

Support
After making the patient comfortable check for denture support, there should be no rocking of the base on insertion and it should cover the entire denture bearing area.

Retention
By holding the denture in the incisal region and trying to pull it downwards. Check the posterior palatal seal by trying to lift the posterior part of denture. If the denture is easily dislodged without any resistance there is lack of retention. There may be a problem with the denture borders check for peripheral seal, overextension, under extension and frenal relief by doing the border molding movements. Find out the cause and adjust accordingly.

Stability

By moving the denture from side to side and applying alternate pressure on premolar region. There should be no excessive movement. Ask the patient to count from 1 to 10 or talk to him/her and observe the denture. It should not fall or move while patient is speaking. If it falls there may be inadequate relief of the freni, or minor over-extension in localized areas, identify & remove the cause.

Esthetics:

Verify esthetics by checking lip & cheek support, smile line high & low lip line.

Mandibular denture:

Now remove the maxillary denture and insert mandibular denture. Check for **comfort**, **retention**, **stability** and **esthetics**. Make the patient comfortable as described above. Note that the lower denture has less retention in comparison with the upper dentures but the patient should be able to talk comfortably without dislodging it. Check the denture extensions by manipulating the cheeks and lips. Also see that distally it should be covering the retromolar pad, distobuccally masseteric notch should be well defined should not interfere with masseter muscle. If the denture is lifting posteriorly after insertion check for overextensions in masseteric notch distal and disto-buccal regions, if it is lifting anteriorly make sure that the labial flange is not over-extended and there is sufficient space for mentalis muscle. Patient should be able to swallow comfortably, if there is a problem check distolingual borders. Check the level of the occlusal plane, anteriorly at the level of the relaxed corners of the mouth and posteriorly at the junction of the anterior 2/3rd and posterior 1/3rd.

Both dentures in mouth

When satisfied with individual dentures, insert both dentures together and evaluate jaw relations, occlusion, speech and stability of dentures.

Speech

Verify patient's speech as already done at the trial stage. Concentrate on closest speaking space, labio-dental (**F &V**), linguo-alveolar (**S,Z**) and linguo-dental (**TH**) sounds.

Jaw relations:

Confirm the occlusal vertical dimension and centric relation by the methods used in recording jaw relations. Make sure that the relations are the same as they were on the articulator.

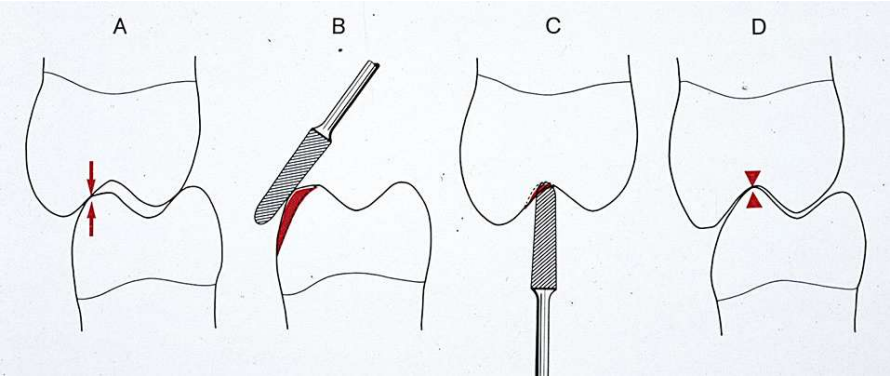
Occlusal adjustments (spot grinding)

Occlusal adjustments are almost always necessary at insertion. It can be done on the chair side with dentures in the patient's mouth or in the laboratory after remounting the dentures on the articulator with new centric relation records.

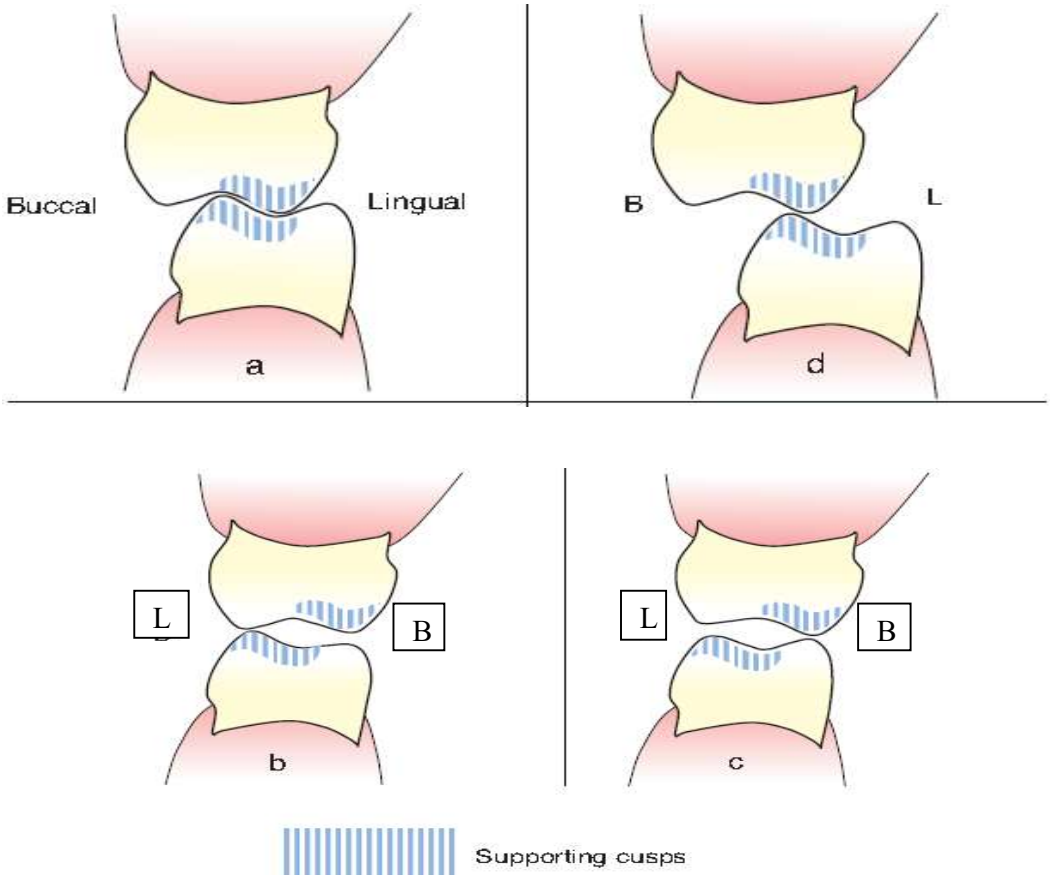
Rules of Occlusal Adjustment

Spare the cups tips grind the pit and fissures (in centric relation only)
Spare the cups tips grind the inclined planes (in centric relation only)
Apply BULL rule i.e., Grind the cups tips of upper buccal cups and lingual cups of lower teeth. (Buccal Upper Lingual Lower) in lateral movements.
Check the occlusal spot and apply the above rules in order.
Take a No.6 or 8 round or fissure bur and just lightly grind the high spots.

Repeat this procedure several times till spots appears on all teeth and all cups.



Spare the cups tips grind the inclined planes/ pit and fissures



BULL RULE

For clinical adjustments a horse shoe shaped articulating paper and burs are require. Insert dentures in the patient's mouth put the articulating paper between the teeth and ask the patient to tap teeth together. Remove the dentures and observe the marks. Identify any high spots (white area surrounded by colored markings) and remove them according to the principals. Repeat the process until even contacts are achieved on both sides. The purpose of spot grinding is to increase the number of contact points on the occlusal surfaces of the teeth. Once the contacts are established in centric relation place articulating paper and ask the

patient to perform side to side and protrusive movements. Remove the dentures and observe the marks. Identify and remove any high spots according to BULL's rule.
A sheet of casting wax may also be used for identifying high spots. The wax will be perforated from areas where there was excessive pressure.

Patient's approval:
When you are satisfied with every aspect let your patient observe the dentures and ask for approval. Before sending the patient home with new dentures give detailed instructions for using new dentures.

DENTURE CARE INSTRUCTIONS

Explain given instructions to the patient

Initial Sensations

When you first begin to wear your dentures, they may feel loose. Until you have learned to keep them in place with the muscles of your cheeks and tongue, they may tip when you chew, allowing food or liquids to pass under them.

No matter how thin the dentures are, they will feel bulky. They may make your tongue feel crowded or may cause a slight gagging sensation. Until your gum and ridges are used to supporting dentures, your mouth may feel sore or irritated. Your saliva flow may also increase temporarily.

After a few weeks, as your oral tissues become adjusted to wearing dentures, these problems should decrease. If you continue to experience irritation or excessive soreness in any area, you should see your dentist.

Appearance

When you first get dentures, your facial expression may seem different. A more normal expression will return when the muscles of your cheeks and lips adapt to the dentures.

Dentures may improve your appearance by changing the shape of your face, and reducing facial creases.

Eating

When you are first learning to use your dentures, it is best to eat soft foods. Cut your food into small pieces and chew slowly on both sides with your back teeth to keep your dentures from tipping. After a few days, when your dentures are feeling more comfortable try coarser and harder foods until you are able to eat a more normal diet. Learning to chew with dentures takes practice.

Speaking

Sometimes, wearing dentures can make a difference in the way you pronounce certain words. To help overcome any speech difficulties, practice reading aloud. If the denture teeth click together when you talk, speak more slowly. Bring any problems to the attention of your dentist.

At first, you may find that your dentures become loose when you laugh, or cough, or even smile. To reposition them, close your teeth together gently and swallow.

When to Wear Your Dentures

You should always take your dentures out before bed at night, and put them back in the morning. This gives your mouth a chance to rest and helps maintain oral health.

Caring for Your Mouth

Even with dentures, you still need to take care of your mouth. Each day before inserting your denture, brush your gums, tongue and palate with a soft-bristled brush, to remove plaque and to stimulate circulation. Visit your dentist regularly (even if you no longer have any natural teeth) for a complete oral examination.

Caring for Your Dentures

For a healthy mouth and fresh breath, clean plaque and food deposits from your dentures daily. This also helps keep the dentures from becoming permanently stained.

Dentures should be handled carefully. Dropping them (even a few inches into the sink) can break the denture base or a tooth. When cleaning or inserting your dentures, hold then over a towel or a basin half-filled with water. And always keep your dentures out to the reach of children and pets.

Before brushing your dentures, rinse them well to remove any loose particles. Next, apply your favorite denture cleaner (or soap) to a moistened brush and clean all surfaces of the dentures. Brush thoroughly but carefully. Scrubbing too hard can damage the denture. Household cleaners and some tooth pastes should not be used because they are too abrasive. Never use bleach on your dentures.

If your dentures become dry, they may change shape. When you take your dentures out at night, place them in a container of denture-cleaning solution or water. Never put dentures in hot water, they can warp.

If your dentures break, crack or chip, or if a denture tooth becomes loose, call your dentist immediately. Dentures can be repair, but try to save the broken pieces.

Long-Term Denture Success

Although your dentures (if cared for properly) will keep their shape, your mouth continues to change. The bone and gum ridges that support your dentures can recede or shrink. If ridge shrinkage occurs, your dentures will begin to feel loose and less stable, and your ability to chew may decrease.

Prolonged use of ill-fitting dentures can irritate the gums, tongue and cheeks and cause the ridges of the mouth to shrink to the point where it will be almost impossible to fit them with normal dentures.

To prevent or correct these problems, you should see your dentist regularly. Your success in wearing dentures depends on you! With a positive attitude, persistence and regular check-ups, you can become one of the millions of people who wear dentures successfully.

POST INSERTION COMPLAINS

COMPLAIN	CAUSE	TREATMENT
Loss of Retention		
At Mouth Opening	Maxilla: Over extension at buccal frenum area Mandible: Over extension at masseter notch area	Trim the periphery at that area using indelible pencil/ pressure indicating paste.
At Mouth Closing	Imperfection in occlusion. Unbalance occlusion	Use articulating paper for spot grinding.
Pain		
Generalized	Excessive denture pressure areas.	Use pressure indicating paste. Relieve & polish
Localized	Premature tooth contact. Imperfection in denture base.	Spot grinding Mark with indelible pencil. Relieve & polish.
At rest	High OVD	If minor than can be adjusted by spot grinding or remake denture at jaw relation stage.
At occlusion	Imperfection in occlusion. Unbalance occlusion	Use articulating paper for spot grinding.
In sulcus	Overextension of flange	Reduce length & polish. Use pressure indicating paste/indelible pencil
In tuberosities	Maxillary teeth are out of the arch	Mount the denture on articulator remove the teeth set them again on the ridge
Swallowing		
Sore throat	Over extension of flange at retro mylohyoid area	Reduce the flange by using pressure indicating paste.
Nausea	Over extension at post dam area and retro mylohyoid area	Reduce the extension carefully not to over cut at post dam area.
Check biting	Reduced vertical height	Reline denture to increase OVD

	Reduced buccal over jet	Increase the thickness of buccal flange which keep the cheeks away from teeth
	Reduced thickness of buccal flange	Increase the thickness of buccal flange with self-cure acrylic
	Loose checks	Advice muscle exercises to patient
Clicking	Increased vertical height	Spot grinding can adjust minor problem. If problem is gross re make denture at the jaw relation stage
	Occlusal irregularities	Occlusal adjustment by spot grinding
	loose lower denture	Reline denture
	Porcelain teeth	Change teeth with acrylic one
Food under dentures	Thin peripheries	Increase thickness of peripheries with self cure acrylic
Esthetics		
	Wrong Teeth shape size color	Change teeth
	Placement	Reset teeth
Phonetics		It adjusts with practice if there is no gross problem in jaw relation and set up teeth
Mid line fractures	Fatigue	Reline or rebase denture
	Opposing natural teeth	Change acrylic base plate with metal base plate
	Deep frenum notches	Use high impact cross linked acrylic or recommend surgery
	Hyper plastic incisive papilla	Give relief or Use high impact cross linked acrylic or recommend surgery
	Palatine tori	Give relief or Use high impact cross linked acrylic or recommend surgery
	Buccal placed teeth	re make denture at the jaw relation stage and set up teeth on the ridge

RELINING AND REBASING

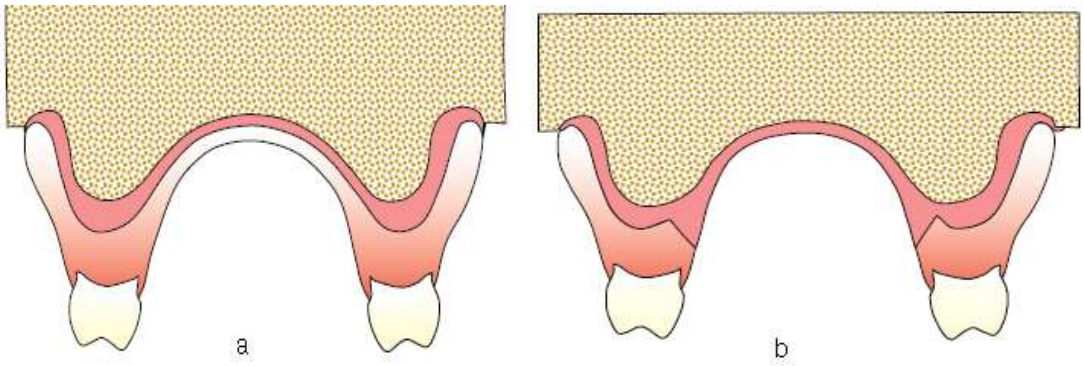
As the patient uses the denture some changes stars to take place in the underline tissues. The supporting bone continues to resorb under denture on a low rate, with time the adaptation of dentures to tissues compromised. The dentures become loose due to loss of retention. At this stage a maintenance phase of denture therapy starts. As patients continues to use denture without consultation these changes become worse and at a stage patient become unable to use dentures. These changes need adjustments with regular bases. To compensate these changes two procedures are recommended i.e., Relining and Rebasing. When the changes are minimum to moderate relining in indicated and when changes are moderate to maximum rebasing is recommended.

Relining

It is the procedures used to resurface the tissue side of a denture with new base material, thus producing an accurate adaptation to the denture foundation area.

Rebasing

It is the process of replacing the entire denture base material on an existing prosthesis with new denture base material.



RELINING **REBASING**

Relining

Indications

Loss of retention

Types

Temporary (chair side)

Permanent

Materials

Acrylic base

Silicon Base

Methods

Direct Method/ Chair side

Indirect Method

Temporary/ Direct Method/Chair side Relining

This method is performed in the clinic on the patient. The impression surface of the denture is roughening by grinding it only 2mm. The relining material is mixed according to ration and applied on the impression surface of the denture. The denture is insert in patient mouth along with opposing denture. Instruct the patient to close the mouth in centric relation (close mouth impression technique). perform the cheek molding as like in secondary impression. The mouth should be closed in centric relation till the material set otherwise denture may move during setting and disturb the centric relation. Remove the denture after setting, trim the excess material, polish it and give it to the patient. The temporary relining materials are mostly silicone based. These materials become hard after few months so they have to be changed frequently or do the permanent relining.

Permanent Relining

The permanent relining is a two-step process. First in clinic and second in lab. In the clinic the impression surface of the denture is roughen and grind it only 2mm. A secondary impression is recorded by ZoE past by close mouth method as for temporary relining. In the lab. the heat cure acrylic is use for relining, for that it is called permanent relining. The "**Reverse Flasking method**"

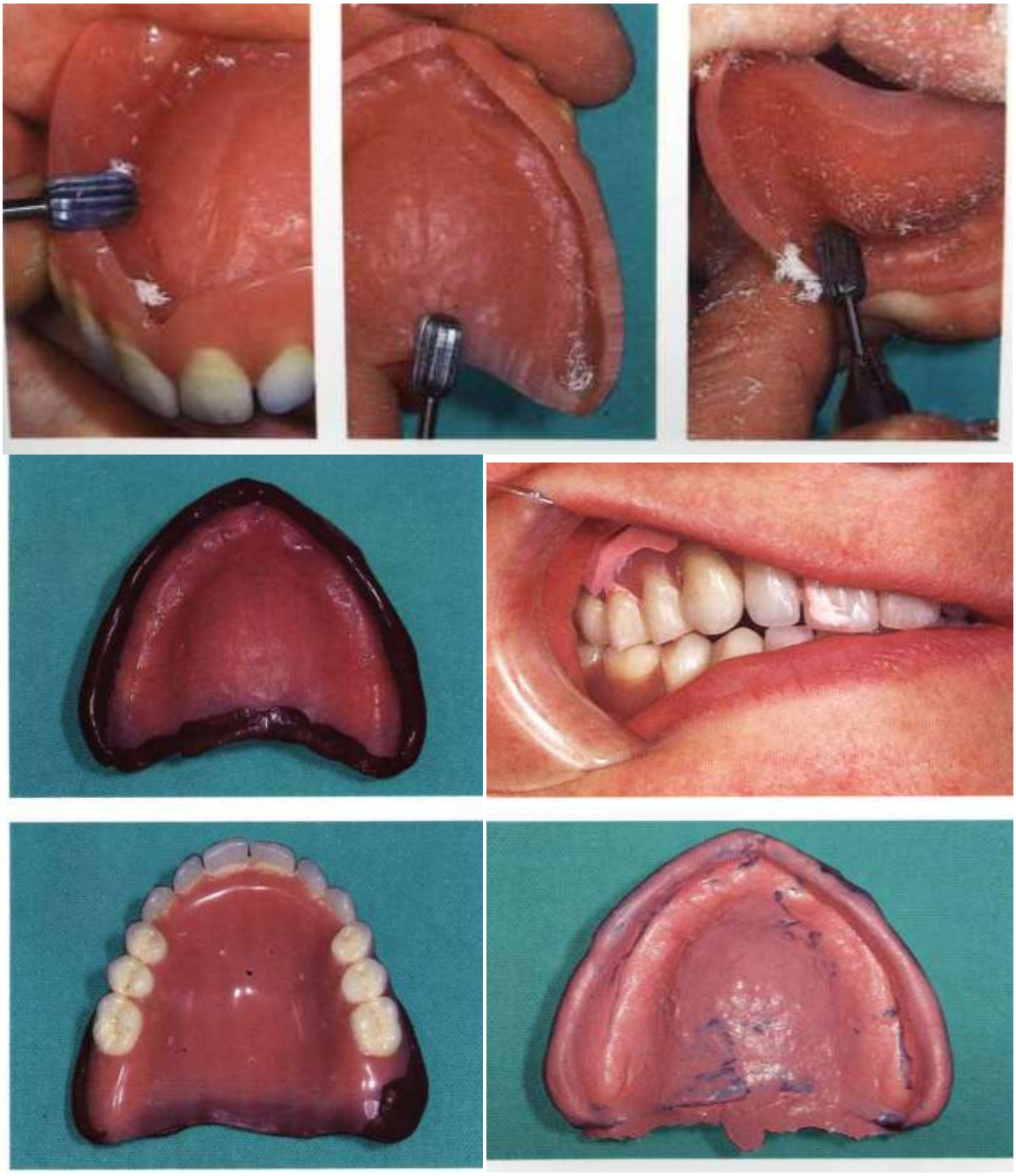
is use for curing of new acrylic layer on impression surface. In this method the relining denture is flask as the teeth are embedded in the lower half of the flask and impression surface is facing upward and pour the upper half. Then open the flask, clean the impression surface, grind the impression surface to create 2-3mm space for new acrylic, pack acrylic and cure as routine. After deflasking trim the excess and polish it and deliver to patient.

REBASING

Indications

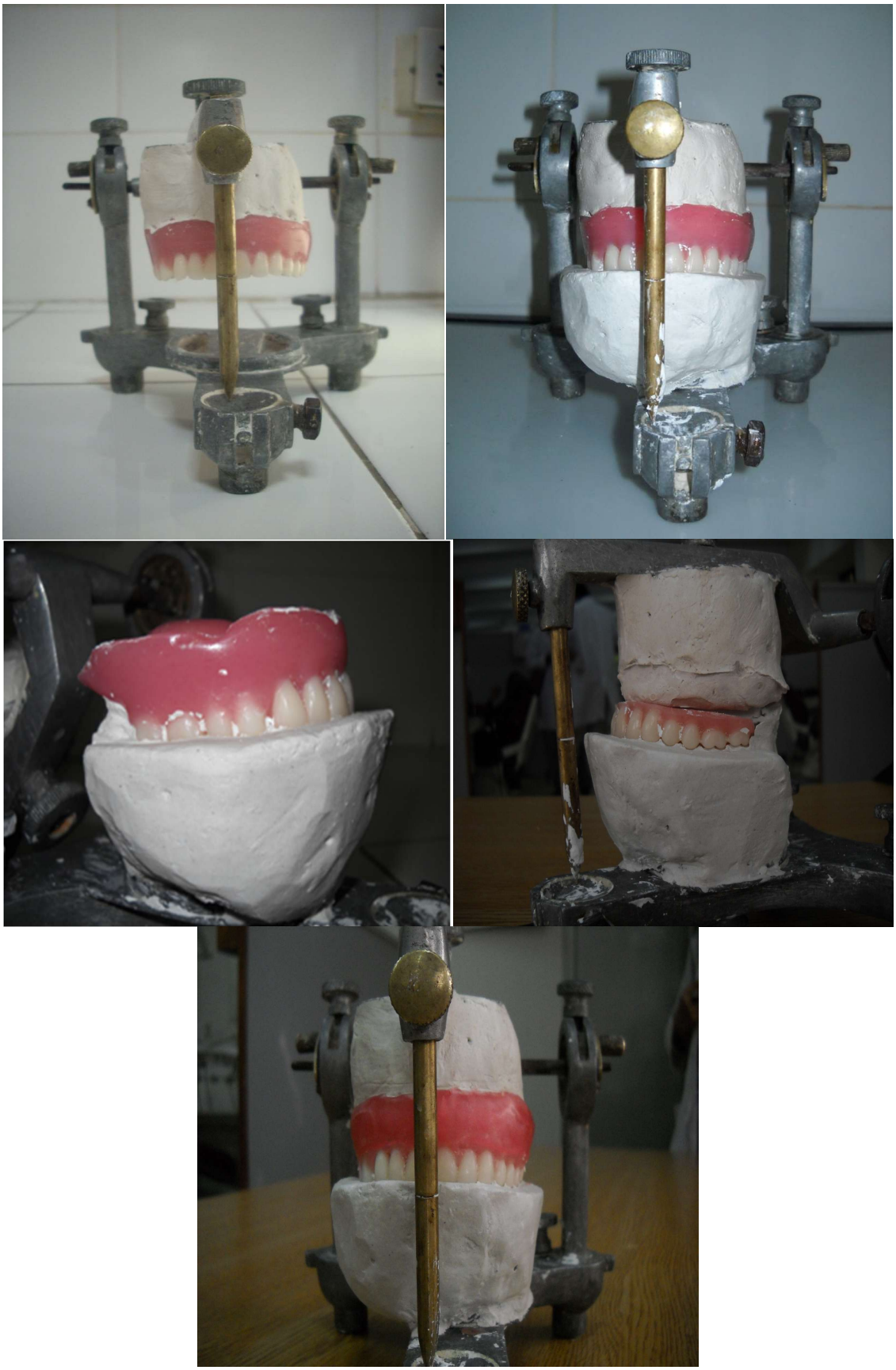
- Loss of retention
- Loss of stability
- Loss of OVD
- Compromised Esthetics
- Horizontal shift of denture
- TMJ problems
- Angular cheilitis
- Discoloration of denture
- Multiple repairs
- Multiple relining
- Porosity of the new denture

In rebasing the denture base has to be removed with new one due to the any of above mention problem. The old denture is considered as a special try. The overextended flanges of denture have to be cut down according to the patients reduced sulcus depth. The impression surface is grinding 2mm. Now record a new secondary impression on this denture. First record periphery and then take a wash impression by close mouth technique as for relining.



In laboratory there are three methods to replace the old denture base with new one.
Reverse flasking method as for relining. It is indicated when the thickness of old denture base is normal as for dentures with porosity or only discolouration of base plate or for repairing of broken denture. The base plate has to be cut down other than a narrow strip attaching teeth. Pack new acrylic, cure, finish, polish as routine.

Articulating Method
This method is indicated when the old denture base plate become too thick due to the repeated relining. The thickness of base plate cannot be reduced by reverse flasking method. In this method articulate the one denture on the articulator. Then make an index of the teeth of the denture with plaster by applying soft plaster to the lower part of articulator till the necks of the teeth of articulated denture on upper part of articulator.
Remove the denture cut down all the denture base plate other than a stripe attached with teeth. Rewax up the base plate and attach with the teeth on the articulator. Finish the wax up proceeds as normal for flasking, curing, finishing, polishing and deliver to patient.



ARTICULATING METHOD

Jig Method is an old technique in which an instrument called Jig is use in place of articulator. Now a days it is not in use as articulating method gives better results. Jig also use same technique of making index of teeth.

Jig

MANAGEMENT OF OLD DENTURE WEARER REQUIRE NEW DENTURES

The prolong use of complete dentures produce changes to the underline tissues. These changes are from simple mucosal inflammation to severe bone loss. The excessive stresses applied to soft tissues without rest cause trauma, deformation loss of resiliency and loss of ability to recover to their original form. The continuous stresses also lead irreversible bone loss under the dentures. This bone loss reduces the occluded vertical height. This loss of OVD shifted the dentures in anterior direction with shifting of centric relation. The loss of OVD also affects the esthetics. It increases the facial cresses and anterior shifting of centric relation creates the prognathic appearance of face. The loss of OVD also reduces the nose chin distance and creates which appearance.

PROBLEMS OF OLD DENTURE WEARER

Deformed Mucosa
Reduced Vertical Height
Loss of centric relation
Loss of Muscle Tone
Loss of Bone
Loss of Esthetics

MANAGEMENT OF OLD DENTURE WEARER BEFORE NEW DENTURE FABRICATION

Soft tissue conditioning
Muscle conditioning
Restoration of jaw relation
Nutritional improvement

SOFT TISSUE CONDITIONING

The continuous use of dentures blocks the thermal sensations to the soft tissues. This causes the loss of stimulation required for keratinization. The reduced thickness of keratin causes the connective tissue edema. This leads sub clinical inflammation then hypertrophy of tissues and then hyperplasia of tissues. The stresses without rest lead to ischemia, trauma, deformation, fibrosis and loss of resiliency of soft tissues. The following steps are required for mucosal conditioning depending upon severity of condition.

Rest
Physiotherapy (messaging)
Tissue conditioners application
Surgery

REST

The stopping of the denture use is the best advice to patients. It removes the cause of problem and provides rest to tissue. It also and increase the thermal stimulation of tissues which increase the blood flow and improve the health of tissues. It is recommended the patient should not use the dentures 48-72 hours before the making of impression for new dentures regardless of any sign of tissue abnormality.

PHYSIOTHERAPY

Messaging of the tissues increases the blood flow to tissues. It removes the irritants and oxygenized the tissues and reduces the edema and inflammation and hypertrophy. The friction

to the tissues also increases the keratinization which is the protective to underline connective tissues. The physiotherapy can be done by
Digital stimulation
Soft Brush
Chewing Gum
Hot Saline
The physiotherapy is advised 5-10 minutes four times per day for at least 15 days.

TISSUE CONDITIONERS APPLICATION
In those cases where the patient is unable to discontinue the dentures the tissues conditioners are advised. These are resilient materials and keep their softness 48-72 hours. The chemically it is acrylic resin consisting of polymer and aromatic ester ethyl alcohol. They are applied on the impression surface of the old dentures. The tissue conditioners provide soothing effect to tissues and distribute the occlusal load evenly on tissue due to their softness and promote healing. They should be replaced every 2-3 days as they lost their resiliency and become hard due to loss of ethyl alcohol. They are advised for 10-14 days.

SURGERY
After all conservative procedures if the soft tissue hyperplasia exists the surgical removal is indicated. The all-conservative procedure should be applied before the surgery because they reduce the size of tissues by reducing the hypertrophy and only hyper plastic tissues left for surgery and prevent the loss of healthy tissues by surgery.

MUSCLE CONDITIONING
Due to lost OVD the muscle also lost tone. To improve the muscles tone exercises are recommended. The exercise is based on stretch-relax concept of the muscles therapy.
The patient is advised to
Maximum open the mouth and held at 30 seconds and followed by relaxation
Move jaw right maximum and held at 30 seconds and followed by relaxation
Move jaw left maximum and held at 30 seconds and followed by relaxation
Protrude the jaw maximum and held at 30 seconds and followed by relaxation
This exercise program is recommended for 3-4 minutes 4 times a day for 15 days.

RESTORATION OF OVD
The bone resorbs under dentures. This is a continuous process which cannot be stop but can slow down. This bone resorption over a prolong period of time severely reduces the OVD and in many cases more than 10mm. This loss of OVD shifted the dentures in anterior direction with shifting of centric relation. The loss of OVD also affects the esthetics. It increases the facial cresses and anterior shifting of centric relation creates the prognathic appearance of face. The loss of OVD also reduces the nose chin distance and creates witch appearance. In the new dentures this loss cannot be restore at once because the muscle used to the reduced OVD cannot tolerate this and become painful. The restoration of lost OVD should be is increments and spread on a long time period depends on patient's adaptation. The appliance used to restore OVD is called occlusal pivot appliance.
STEPS IN RESTORATION OF OVD
Copy the patient's old dentures
Make flat the posterior teeth of mandible denture
Make a flat plate form with self cure acrylic on posterior teeth
This plate form is used to increase the OVD by increments

Restore at least half of the lost OVD by applying self cure acrylic on these platforms by adjusting OVD in patient's mouth.
Give the denture to patient for use for 1-2 weeks.
This time can be adjusted by patient's response. If patients adjusted on new OVD early than reduce the time and if not than reduce the OVD and increase the time.
When the patient become comfortable on this OVD then again increase the height of platform by adding acrylic in 2mm thickness and give the denture to patient for use.
On next appointment again increase the OVD in the same way.
Repeat this process till desired OVD achieved with patient comfort.
By restoring the OVD the centric relation also be restored as the mandible moves back ward to its centric relation with each increment of increase in OVD.

Occlusal Pivots on the lower dentures

MANAGEMENT OF LOWER ANTERIOR TEETH OVER ERUPTION

- 2 mm enamel-plasty
- 4mm elective endo and crown reduction
- 6mm over denture abutments
- > 6mm extraction with alveoloplasty

NUTRITIONAL IMPROVEMENT

The patient is advised to improve diet and add fibrous diet. The food supplements are also advisable. The multivitamins should also be advised. In severe case the patient should be refer to a nutritionist.
Now the patient is ready for new denture fabrication.

COPYING DENTURES

This is the method to make duplicate of patient's existing dentures.

INDICATIONS
Patient needs a spare denture
To duplicate polished surface of old denture
Treatment dentures
Change the base plate due to porosity

ADAPTATION TO DENTURES
The use of dentures by a patient depends up the adaptation of the patient's oral musculature and brain with the new environment. The adaption has two components
1. Habituation
2. Learning

HABITUATION
It is a gradual reduction in response to a continuous or repeated stimulus. When the patients start to use dentures the mechanoreceptors of the oral cavity start to send up the new sensory information to the sensory cortex in very excessive amount. With time the mechanoreceptors of the oral cavity change themselves according to the shape of the dentures and reduce the information sending to sensory cortex. This process continues and the receptors completely adjust themselves with dentures and the patient loss the feeling of dentures in mouth. Whenever the patient changes the dentures with new one the same process of habituation starts again.

LEARNING
It is the ability to acquire new skills. The learning new skills required repetition. The driving car first required conscious efforts initially. In second stage the driving needs fewer conscious efforts as the body parts became programmed. In third stage the driving process works without any conscious efforts. In the same way when patient starts to use dentures it needs conscious efforts to hold the denture and use it. The repetition creates new reflex arcs between muscles and brain. The constant repetition of impulse lowers the synaptic resistance and facilitates new reflex formation. In this way the new reflexes generated and the conscious efforts to hold the dentures became subconscious efforts.
Learning and habituation depends upon

AGE
With increase age the more difficult for body to make new reflexes.

MOTIVATION
Higher the motivation of patient the higher will be the level of learning.

EXPERIENCE
The previous of denture use also helps in adapting to new dentures.

HEALTH

The good health promotes early learning and making of new reflexes.

The purpose of copying the old dentures of patient is to provide same polished surfaces so the body can adapt to new dentures without starting the process of habituation and learning once again as any little change in dentures shape can be read by body a new structure and starts the process again. The adaptation process slows down with increasing age and deteriorating health. So, it is more beneficial to old patients to provide the new dentures with the same polish surface as old once have.

METHOD

The dentures can be duplicated by using

Soap box

Duplicating Flask

Impression Trays

Take a soap box and cut two holes on one side

Take old dentures and put two wax sprues on posterior end each side

Fill the one half of soap box with mixed alginate

Embed the denture in this mix of alginate teeth side down

Wait for the setting of alginate

Fill the other half of soap box with mixed alginate

Put this half on the other half of soap box and close it

Put some elastic band on the box

After setting of Alginate open the box

Remove the denture

Close the box again without denture

Mix a thin mix of self-cure acrylic

Pour the acrylic from on hole in soap box

Pour till the acrylic comes out from the other hole

Wait for the curing of acrylic

Open the box and remove the copy denture

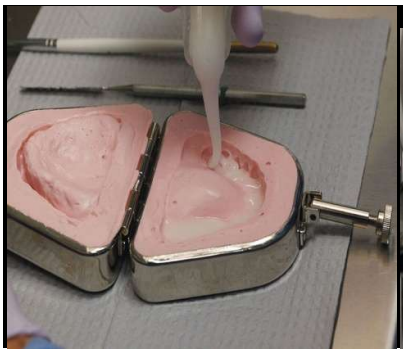
Cut out the sprues and finish the denture

The teeth portion can also be poured with the melting wax and the base with acrylic as depends upon the requirement.

Now this copy denture can be adjusted as required as recording secondary impression and adjusting vertical height.

After adjusting now articulate the copy denture

The new teeth can be set by cutting self-cure acrylic teeth alternatively
After set up take trial of denture
Process the denture and remove the self cure acrylic bases after de waxing
Pack the heat cure acrylic and process the denture.



OVER DENTURES

It is a denture supported by the natural teeth or roots of teeth. It may be complete over denture or partial over denture. The teeth and roots have to be treated endodontically and the crowns have to be prepared by simply amalgam plug to coping crowns and to attachments. It is always better to save few teeth or roots for support of dentures. The biggest advantage of saving teeth is the preservation of bone as stimulation of periodontal ligaments helps to maintain alveolar bone.

ADVANTAGES

Preservation of alveolar bone
Maintenance of tactile discrimination sense
Better stability, support and retention
Better mastication
Psychological benefits
Better future adaptability to complete dentures
Easily convertibility into complete dentures
Less maintenance
No need of relining & rebasing due to no bone loss

DISADVANTAGES

Maintenance of high level of oral hygiene is required
Increased cost & treatment time due to endo and coping crowns
Development of undercuts around abutments
Reduced inter maxillary space
Over contouring due to labial undercuts
Under extension of flanges due to undercuts

CONTRAINDICATIONS

In patients with rampant caries
In patient with poor motivation
Any contraindication to endodontics as endocarditis

INDICATIONS

Over dentures are indicated in patients with
Worn-down or mutilated dentition
The reasons of mutilated dentitions are
- Attrition & Erosion
- Patient Neglect

Dentinogenises imperfecta
Emelogenasis imperfecta
Patients with Congenital & acquired defects of jaws as
- Clefts
- Jaw size discrepancies
- Surgical defects
- Hypodontia (ectodermal dysplasia)

Patients with few teeth remaining
Teeth with poor prognosis

Remaining teeth not suitable for RPD abutment
Position, angulations, over eruption, mal alignment, broken down crown
Patients with poor soft tissues health of supporting area
Diabetic patients
Radiotherapy patients

ABUTMENT SELECTION

There are few rules which follow during selection of over denture abutments.
Retain as many teeth as possible, it may increase cost
Isolated teeth are preferable due to easy hygiene
Anterior teeth preferable then posterior because anterior ridges are weak
Single rooted preferable then multi rooted teeth due to endodontic prognosis is better and less costly
Most suitable abutment is canine because it has single and long root and also in anterior weak ridge.

ABUTMENT PREPARATION

The abutment can be prepared as follow depending upon the requirements

1. Reduction at gingival margins filled with restorative materials
2. Reduction at gingival margins covered with cast coping
3. Coping crown preparation
4. Attachments

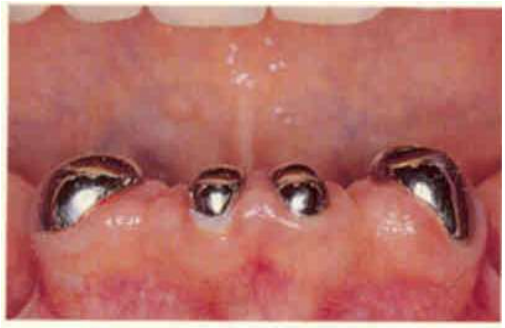
REDUCTION AT GINGIVAL MARGINS FILLED WITH RESTORATIVE MATERIALS

This type of preparation is most suitable because it has no problem of inter arch space. It can be done on perio-compromised teeth as cutting of crown improve the crown root ratio. It has low cost. It cannot be given in high carious cases.

REDUCTION AT GINGIVAL MARGINS COVERED WITH CAST COPING

The covering of the prepared root surface can prolong the life span of tooth. It is also recommended in high carious cases. The copying covering increased the cost. The indications are the same as above one.

Roots with amalgam plugs



Roots with cast copings

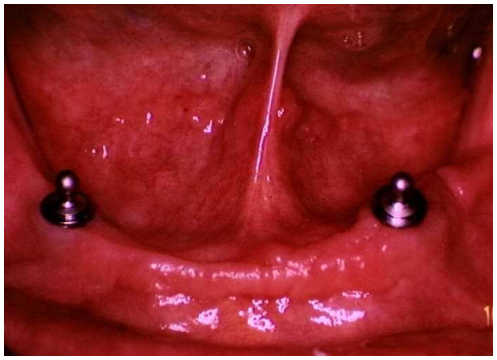
COPING CROWN PREPARATION

This type of preparation needs abutment with healthy periodontium. They are indicated where sufficient inter arch space is available. The abutments are bi laterally present. This increases the cost of treatment. This preparation gives good retention and good stability.

ABUTMENTS WITH ATTACHMENTS

The different types of attachments can be fixed in prepared abutment roots. This type of preparation needs abutment with healthy periodontium. They are indicated where sufficient inter arch space is available. The abutments are bi laterally present. This increases the cost of treatment. This preparation gives maximum support, stability and retention.

Copying crowns



Abutment roots with attachments

IMMEDIATE DENTURES

The Dentures fabricated before the extraction of the teeth and inserted immediately after extraction of those teeth are called immediate dentures. Immediate dentures can be partial or complete dentures.

ADVANTAGES

It eliminates the edentulous period
There is no interruption in normal life
It helps to maintenance the appearance and esthetics
It also helps to maintenance
Mastication
Vertical relation
Muscle tone
Speech
Tongue size
Centric relation

It facilitating adaptation to dentures
It maintenance the patient's physical and mental well-being
It helps in arrangement of teeth like patient's own
It also acts as a surgical matrix after extraction of multiple teeth

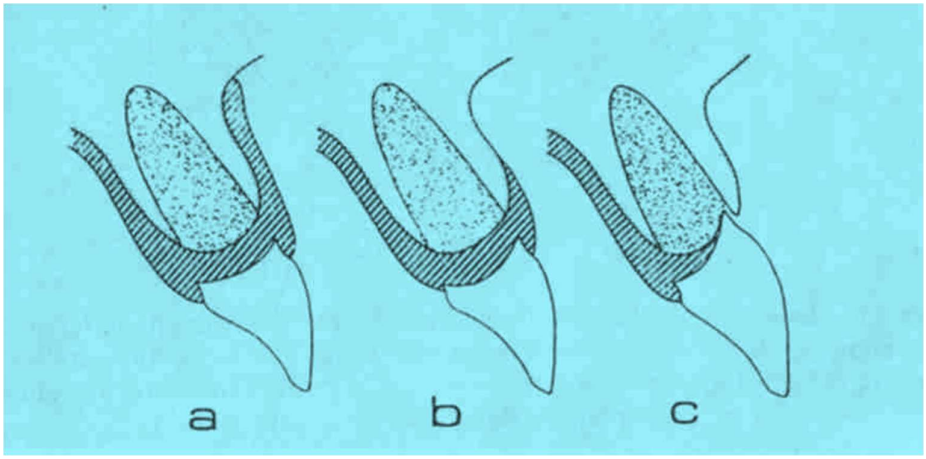
DISADVANTAGE

Multiple visits for maintenance
Costly treatment
Temporary or transitional dentures
No try in

TYPES OF IMMEDIATE DENTURE

The types depend upon the presence and form of labial flange.

1. Complete flange immediate dentures (a)
2. Partial flange immediate denture (b)
3. Open face immediate dentures (c)
4. Delayed immediate dentures



PROCEDURE

- Extraction of posterior teeth
- Keeping one centric stop
- Waiting for healing
- Impressions
- Jaw relations
- Try in of posterior teeth
- Removal of anterior teeth on cast alternatively
- Processing of denture
- Extraction of anterior teeth
- Insertion of immediate denture

POST INSERTION CARE

Patient should not remove denture within 24 hours
24 Hour Follow-Up
Adjustment of pressure points and occlusion
48 Hour Follow-Up
Adjustment of pressure points and occlusion
Advice to clean denture many times a day
Use warm saline for rinses
Keep dentures at night for 3 days
7 Days Follow-Up
Apply Tissue conditioner after every 7 days
4 Weeks Follow-Up
Relining the denture
6 Month Follow-Up
Fabricate new dentures

RESIDUAL RIDGE REDUCTION

After the loss of all teeth the remaining residual ridges change shape and reduce in size at varying rates in different individuals and in same individual at different times.
This is the localize loss of bone and not affect the other bones of the body. It is the normal remolding process of the bone which continues all over the life span. It is very active in child hood, slow down in adult hood and again accelerated in old age. It also increases in osteoporosis.
Residual ridge reduction is a localized pathology. It is irreversible and inevitable and continues beyond alveolar bone. The pattern of RRR established early after the teeth loss and maintained throughout life. It is worldwide equally affecting the male and female. It continues with or without dentures. It is unrelated to the primary cause of extraction of tooth that is periodontal or caries. We cannot stop it but only reduce its speed.

ETIOLOGY
It is a Multi factorial, Biomechanical disease and effected by the combination of multiple factors which can be divided in following groups

1-Anatomic factors
2-Metabolic factors
3-Mechanical factors

ANATOMIC FACTORS
Quality and quantity of bone affects the rate of RRR. The greater the bone volume the greater will be the loss. The cortical bone resorbs more than spongy bone as more RRR is seen in mandible then maxilla with the ratio of 1:4. The direction of alveolar bone guides the direction of bone loss. The direction of alveolar process in maxilla is down and outward so the direction of bone loss is upward and inward. The direction of alveolar process in mandible is upward and inward so the direction of RRR is downward and outward. This direction of RRR causes the discrepancy of jaw size, with time the maxilla become smaller and mandible become larger respective to each other. This discrepancy of jaw size creates a prognathic appearance of person will Angle's Class I. this is called Pseudo prognathism.

METABOLIC FACTORS
There are many metabolic factors which can affect the bone health and RRR. These are poorly understood and beyond the control of a prosthodontist. The patient's physician's advice is required.
Local Factors
Local bone resorbing factors
Endo toxins

Periodontal bone loss
Traumatic bone loss

Systemic Factors

Hormone's disturbance
Estrogen, thyroxin, growth hormones androgens
Calcium, phosphores, vitamine D, fluoride déficiences
Poor Health
Osteoporosis & Metabolic diseases as diabetics

MECHANICAL FACTORS

The mechanical factors are related to the forces applied on the residual ridges.
The factors of force are
Amount of force
Frequency of force
Direction of force
Duration of force
Area of force
Damping effect of bone

The greater amount of force on small area, continuous applied force, repeatedly applied force, forces applied on lateral directions all causes increase rate of RRR.
The area spread of forces is reduced with the loss of teeth and periodontal ligament. The total area of periodontal ligament in each arch is 45cm square. While an edentulous maxilla has 23cm square and mandible 13cm square, less than the single arch of periodontal ligament area. So, the same forces have less area to disperse and causes increase forces on per unit area of bone more than the physiological limit of bone and leads to RRR.
Damping effect of tissues also affects the RRR. The quality of bone directly affects the bone resorption. The cancellous bone is soft so it has the damping effect on forces and tolerates larger forces while cortical bone is hard and has no damping effects. Due to this the maxilla with cancellous bone shows less bone resorption than mandible which mostly has hard cortical bone.
The soft tissue covering of bone the Mucoperiosteum also acts as a shock absorber in spread of forces. The healthy mucosa with 2mm thickness is good for bone health while mucosa less than 2mm thickness transfer all forces on the bone causes increase bone resorption.
RRR is a multi factorial disease in which different variables in infinite verities of combinations may combine to cause the disease in a given patient.
The best way of preventing the RRR is to save natural teeth. By saving even two teeth in arch and providing the over denture can prevent the RRR. The presence of periodontal ligament provides the stimulus for bone deposition and prevents RRR. In edentulous patients the RRR cannot be stop it can only be reduced.
The anatomical and metabolic factors cannot be changed. The only force factors can be controlled by designing the prosthesis to reduce the RRR. It can be done by

a. Spreading the forces on wider area of bone

b. Decreasing the forces on bone
These can be done by
Broad area coverage of denture base area.

Decrease number of dental units i.e. reducing size of occlusal table

Decrease bucco lingual width of teeth i.e., reducing the width of occlusal table

Improved tooth form by using cusped teeth i.e., applying cutting forces rather than crushing forces.

Providing balance occlusion, lingualized occlusion.

Centralization of occlusal contacts i.e., creating vertical forces.

Adequate tongue space i.e., avoiding continuous tongue forces.

Adequate inter occlusal space i.e., avoiding continuous occlusal forces.

No use of dentures during sleep i.e., resting the tissues.

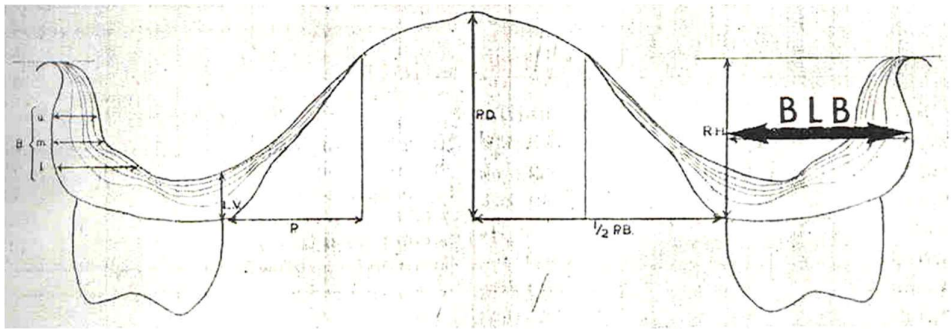
By inserting dental implants for denture support.

BIOMETRIC GUIDELINES

These are anatomical landmarks on the mouth and the face that allow the prosthodontist and his dental technician to fabricate the dentures as to restore esthetics phonetics and function as near to natural teeth as possible.
The biometric guidelines can be divided in groups according to the procedure in which it can help to restore patient as near as to pre-extraction position.
1- Guidelines help in impression recording
2- Guidelines help in jaw relation records
3- Guidelines help in selection and arrangement of teeth

BIOMETRIC GUIDELINES FOR IMPRESSION RECORDING

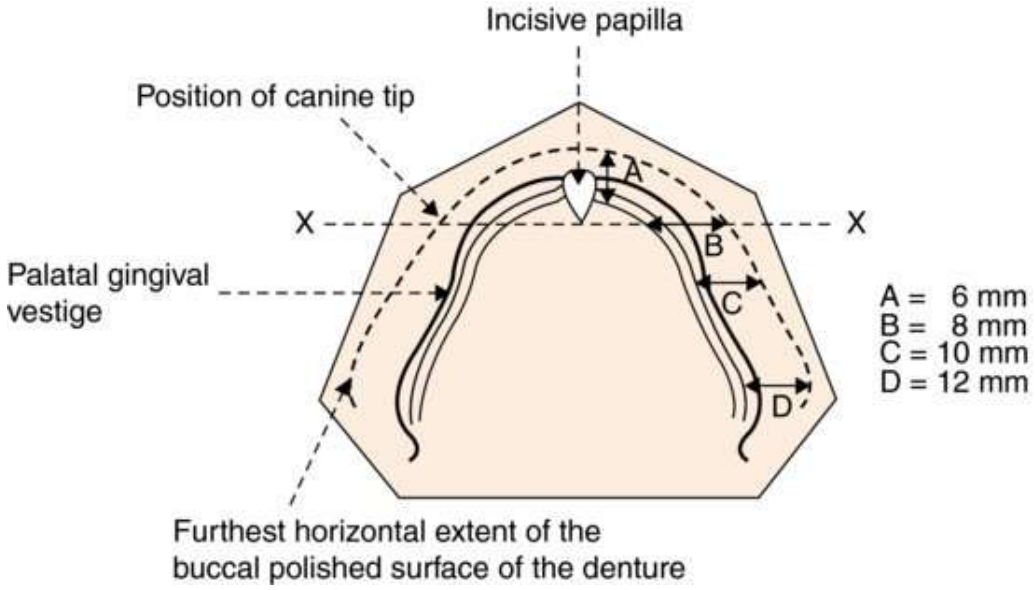
After extraction of teeth the gingival tissues and inter dental papilla are lost except incisive papilla and lingual free gingival margins in maxilla. In experiments it is observed that the lingual free gingival margins on maxilla keep it position in relation to mid palatal suture constant after the loss of teeth. The change of position occurs only on buccal side of the remnant of free gingival margin due to bone resorption. If the pre extraction bucco lingual breath of the alveolar process from free lingual gingival margin be recorded than the teeth can be placed on their natural position in the dentures by the help of these guidelines. The data collected by researchers showed that the distance of lingual free gingival margin in maxilla and the buccal surface of teeth, i.e., buccolingual breath of alveolar process, is nearly constant in individuals and it is as follow
Incisor region 6mm from incisive papilla
Canine region 8mm from remnant of gingival vestige
Premolar region 10mm from remnant of gingival vestige
Molar region 12mm from remnant of gingival vestige



These measurements can be used to fabricate a special impression tray. This tray, called Biometric tray, can record the impression by reposition the lips and cheeks at their pre-extraction position and restore the esthetics of patients.

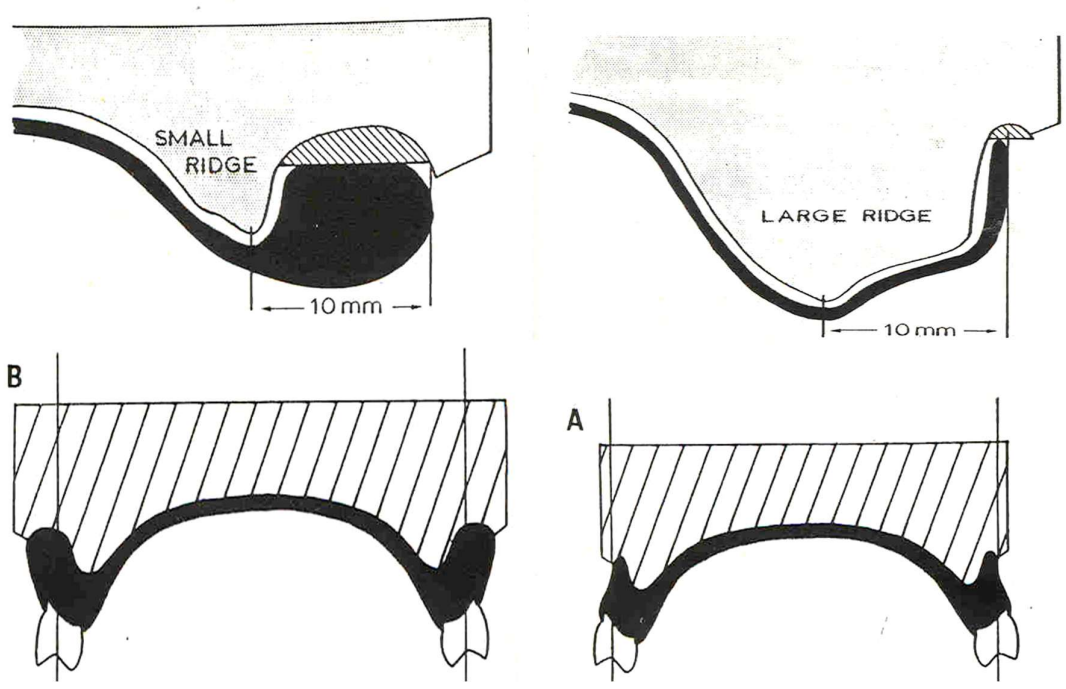
METHOD OF FABRICATION

First record the primary impression in an over extended impression tray
Mark the incisive papilla and remnant of free gingival margin on maxilla cast.
Mark the sulcus according to the measurements in all regions.



Now fabricate the impression tray and cover the sulcus till the marks.

In this way the resulting special tray will have thick peripheral boarders which keep the lips and cheeks at their pre extraction position during impression recording. In cases with less bone resorption the periphery will be narrow and with more bone resorption the periphery will be found thick.



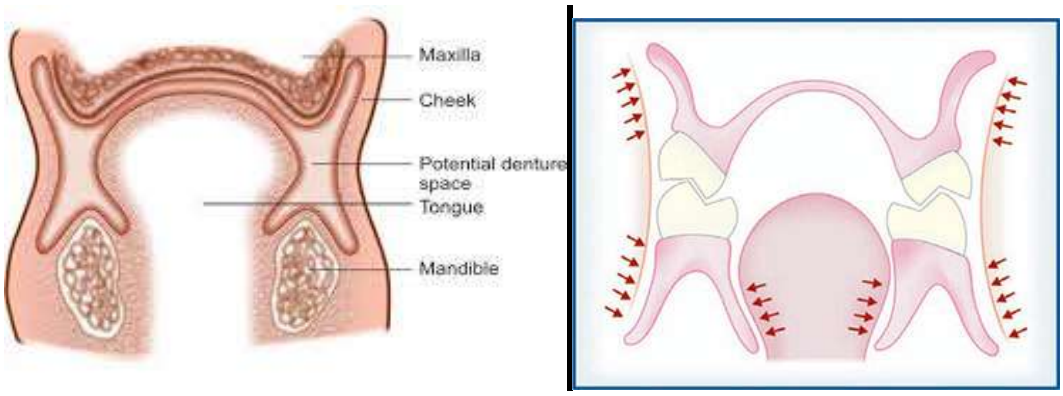
BIO METRIC GUIDELINES HELP IN JAW RELATION RECORDS
BIO METRIC GUIDELINES FOR SELECTION OF TEETH

The details are found in relevant section.

NEUTRAL ZONE COMPLETE DENTURE DESIGN CONCEPT

DEFINATION

"The area in the mouth where during function, the forces of the tongue pressing outwards are neutralized by the forces of the cheeks and lips pressing inwards."
This is also called Zone of Minimum Conflict.



It is in this zone where the natural dentition lies, and this is where the artificial teeth should be positioned. By placing the denture teeth in the neutral zone, the surrounding musculature act as a stabilizing force for the denture during function rather than displacing force. This area of minimal conflict may be located by using the neutral zone technique. The artificial teeth can then be set up in the correct positions.

INDICATIONS

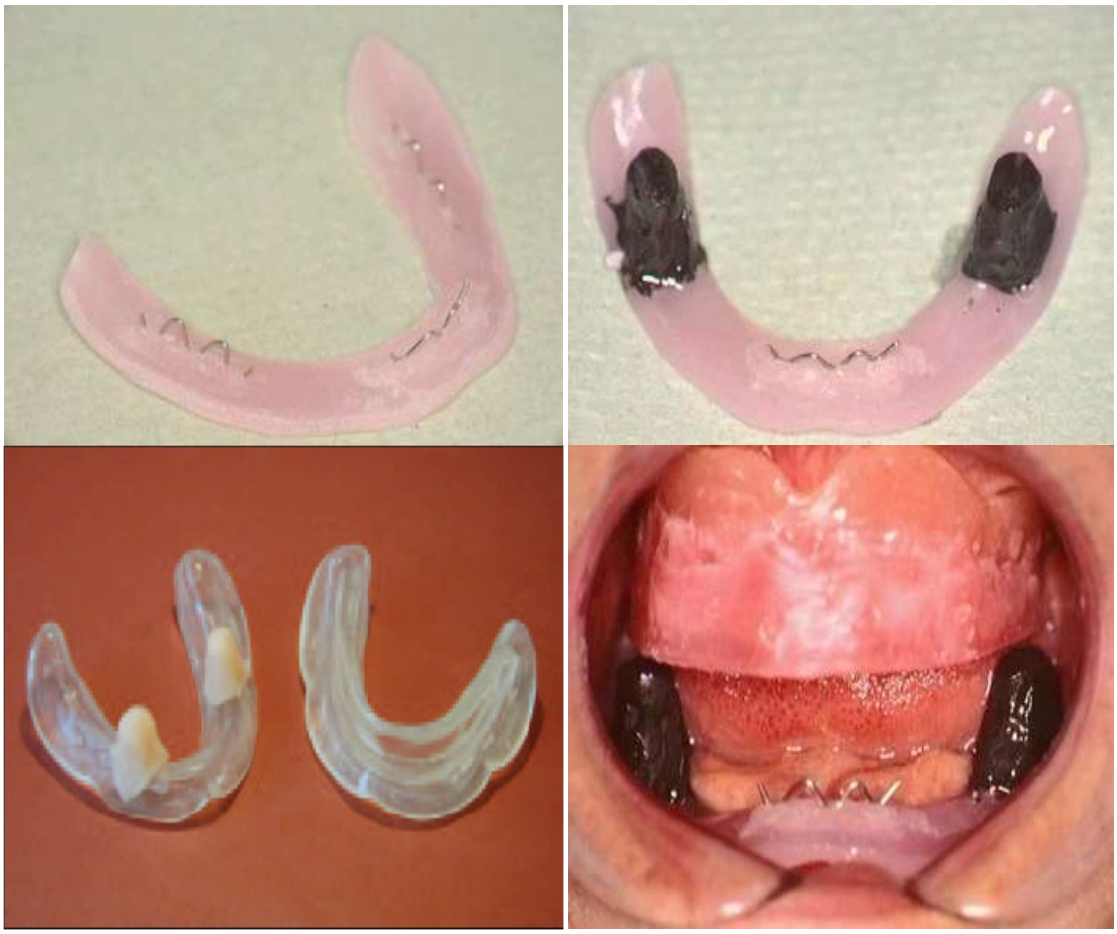
The neutral zone technique is recommended is all patients but following patients can be benefited more
Extremely resorb atrophic mandibular ridges
History of unstable, non-retentive lower complete dentures
Where implants cannot be given because of medical, surgical or cost factors
Difficulty in placing the lower artificial teeth due to strong mentalis muscle
In patients with surgical defects as Partial glossectomy & Mandibular resections
Patients with motor nerve damage of facial muscles

ADVANTAGES

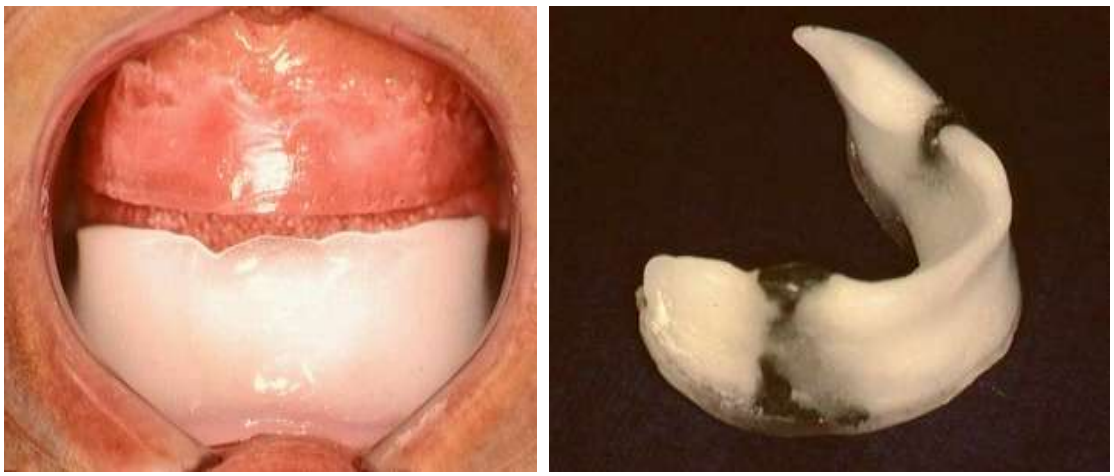
The denture shaped by the neutral zone ensures that the muscular forces are working in harmony with the denture.
Improved retention and stability
Provide sufficient tongue space
Reduced food trapping
Good esthetics and facial support

TECHNIQUE

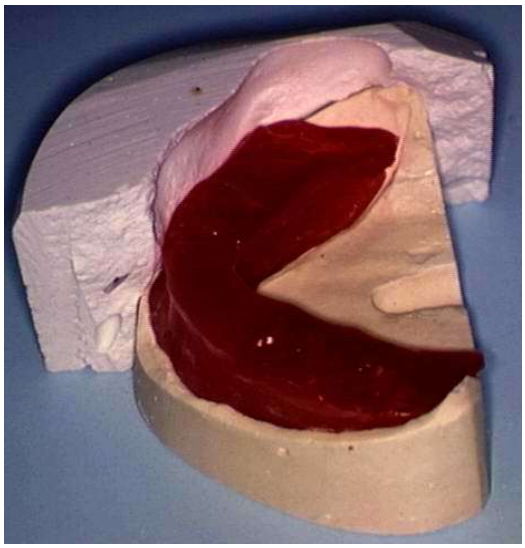
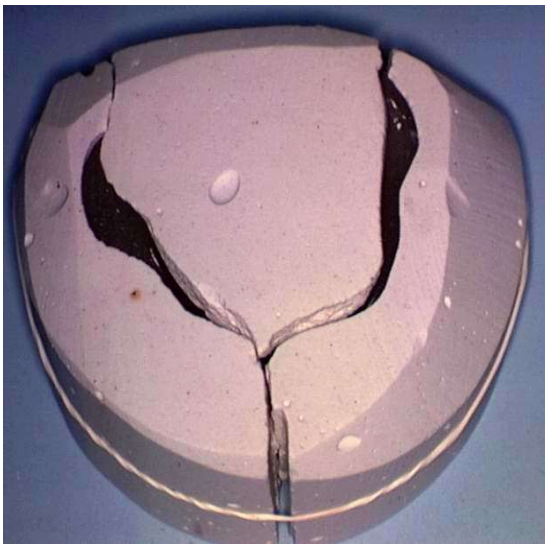
The neutral zone recording starts after the articulation of jaw relation record.
Remove the wax from lower base plate and make a super structure to maintain the OVD and hold the impression material by using self-cure acrylic and metal wire. Two occlusal pillars are then built up in self-cured acrylic on opposite sides of the lower arch. These pillars are adjusted according to patients OVD on articulator.



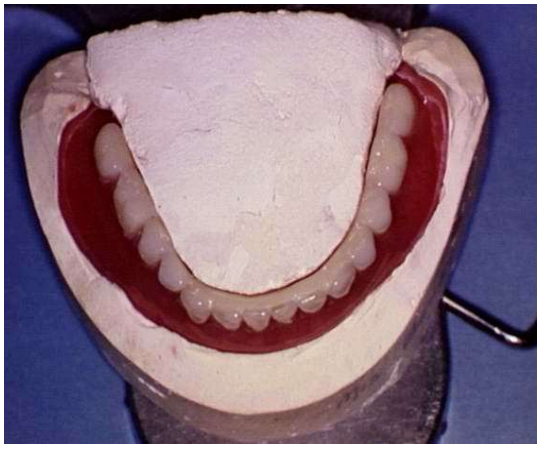
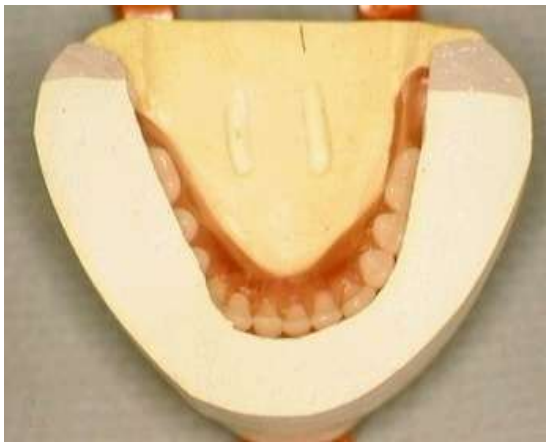
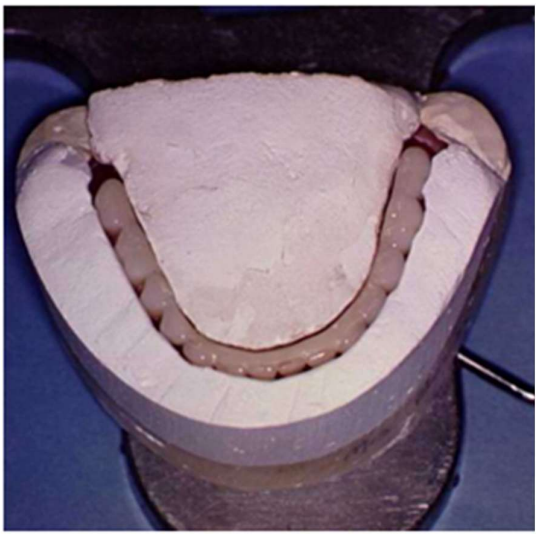
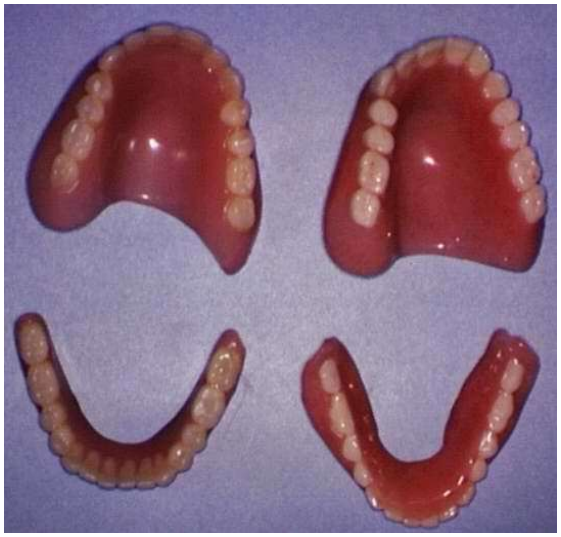
The impression compound or silicon putty or tissue conditioner is then placed around the wires and occlusal pillars. The patient is then asked to talk, swallow, drink some water or perform sucking movements. After 5-10 minutes the set impression is removed from the mouth and examined. If the impression compound is used than it can soft again and perform the movements again. The impression material will be molded by the patient's musculature into a position where tongue and facial musculature come into balance.



To secure the neutral zone recorded the plaster indices are constructed around the impression in three parts.

Then remove the impression material and placed the teeth into the neutral zone.

The resulting denture will feel more comfortable and more stable and retentive because the denture will not interfere with or be displaced by the functions of the lips, cheeks and tongue.

COMBINATION SYNDROME (Kelly's Syndrome)

This is the problems of upper complete denture opposing by natural teeth.
In patients who has edentulous maxilla and Kennedy's Class I mandible when restored with dentures showed a combination of signs and symptoms after prolong and unsupervised denture wearing.

SIGNS AND SYMPTOMS

EXTRAORAL FEATURE:
Prognathic appearance
Loss of facial muscle tone
Increase in columella philtrum angle
Nose chin approximation
Deepening of the mentolabial fold
Thinning of the lips
Angular cheilitis

INTRAORAL FEATURE:
Mobile pre maxilla
Mobile hanging maxillary tuberosities
Papillary hyperplasia of hard palate
Epulis fissratum
Over eruption of lower anterior teeth
Bone resorption of edentulous mandible area
Bone resorption of maxilla
Loss of vertical dimension
Occlusal plane discrepancy, reverse occlusal plane
Anterior positioning of the mandible

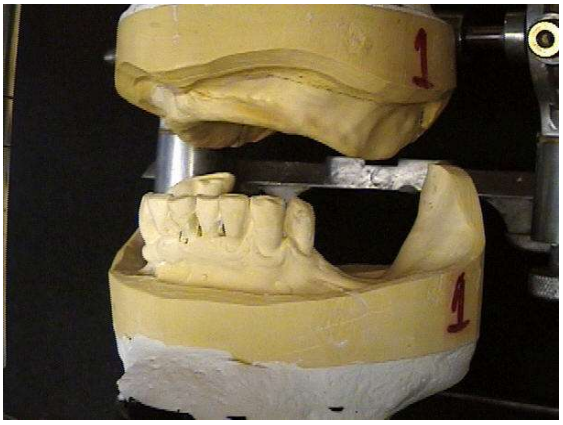
Mobile pre maxilla

Mobile hanging maxillary tuberosities

Reverse occlusal plane

Papillary hyperplasia of hard palate

Over eruption of lower anterior teeth



Bone resorption

ETIOLOGY

Bone resorption in posterior mandible
Loss of occlusal vertical dimension (OVD)
Unsupervised denture wearing

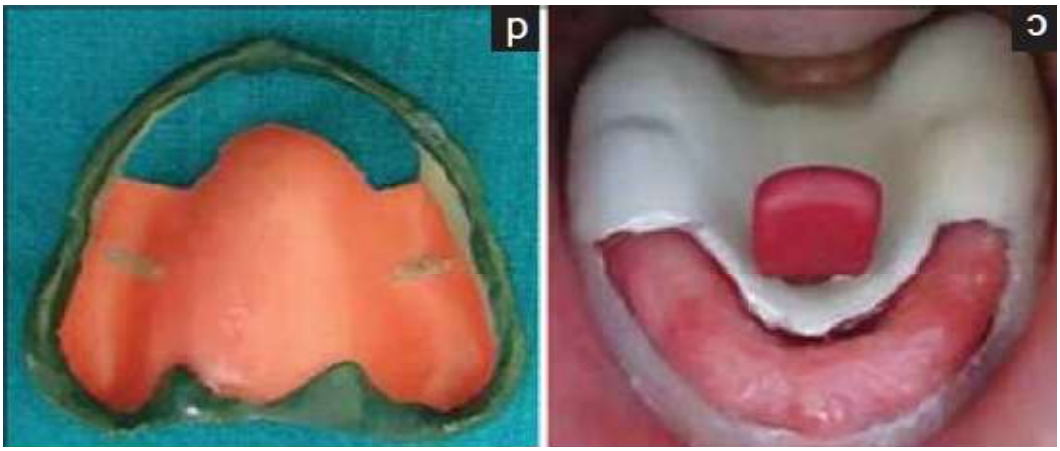
PATHOPHYSIOLOGY

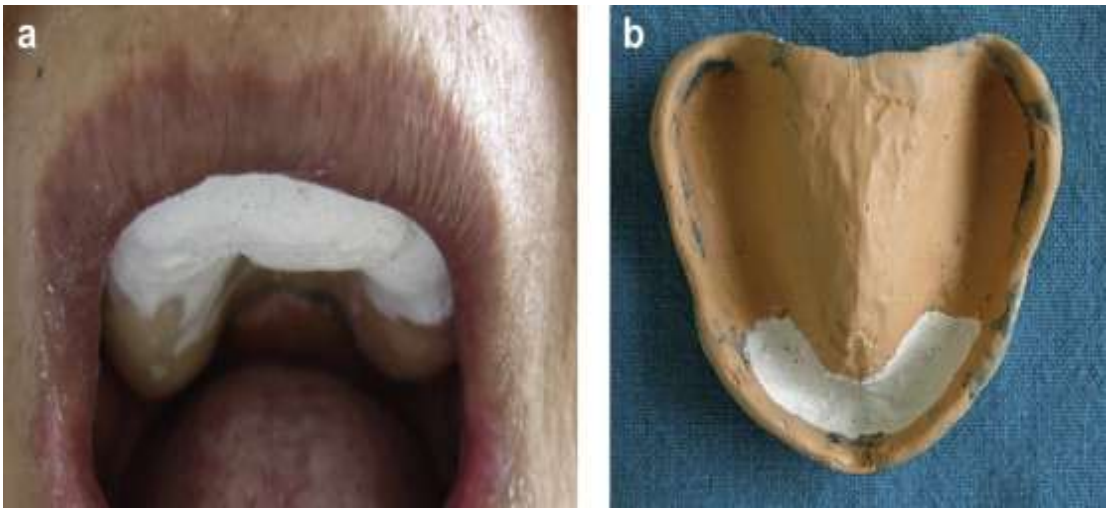
The resorption of the bone under denture bases especially of the mandibular shifted the occlusal contact on anterior teeth.
The contact of the anterior teeth with the upper complete denture transfers the heavy occlusal load on the anterior maxilla.
Anterior maxilla has the poorest bone quality and resorbed rapidly.
The resorption of the bone creates a space between the basal tissues of pre maxilla and the denture.
This space under the upper denture stimulates the growth of the soft tissue to fill the gap and causes **hyper mobile or flabby anterior maxilla**.
The contact of the natural teeth with the anterior maxilla and loss of posterior occlusal stops causes the tipping of the upper denture.
This tipping causes on and off breakage of posterior palatal seal.
This posterior dropping of the maxillary denture stimulates the soft tissue growth at the maxillary tuberosities to fill the gap and causes **hanging maxillary tuberosities**.

The movements of the upper denture also stimulate the soft tissue growth at the hard palate and causes **papillary hyperplasia**.
The bone resorption of the maxilla leads to the over extension of the denture flanges. These over extended flanges traumatized the soft tissues in the sulcus and cause **epulis fissratum**.
The bone resorption causes loss of occlusal vertical height and shifting of the mandible anteriorly.
This altered jaw relationship creates **poor esthetics, loss of muscle tone, deepening of facial folds, prognathic appearance, increase in columella philtrum angle, nose chin approximation, deepening of the mentolabial fold, thinning of the lips and Angular cheilitis.**
The over eruption of the lower anterior teeth further increases the occlusal load on anterior maxilla and also **altered the occlusal plane**.
The severity of all these problems depends on time period of unsupervised denture use. The age, health, disease, nutritional imbalance, metabolic disturbances, medication, para functional habits and night wearing of the prostheses are further contributing factors.

MANAGEMENT OF COMBINATION SYNDROME
The management of these problems can be divided into following categories.
SOFT TISSUE MANAGEMENT
As describe in section of management of old denture wearer required new dentures.
RESTORATION OF ALTERED JAW RELATION
As describe in section of management of old denture wearer required new dentures, by the help of occlusal pivot appliance in set wise manner.

PROVISION OF NEW PROSTHESES
After these steps new dentures are advice. The special care is the flabby anterior maxilla. It should be recorded in mucostatic state so the occlusal load should be transfer to other parts of ridge. The impression technique use is called Window technique. It is variation of selective pressure technique. The impression tray is cut down in the area of the flabby ridge to make a window in tray. The impression of the other arch is recorded as usual other than window area. At end the impression is place in mouth, a mucoststic impression material like impression plaster in painted on the tissue in the window. Try to not disturb the flabby tissue.



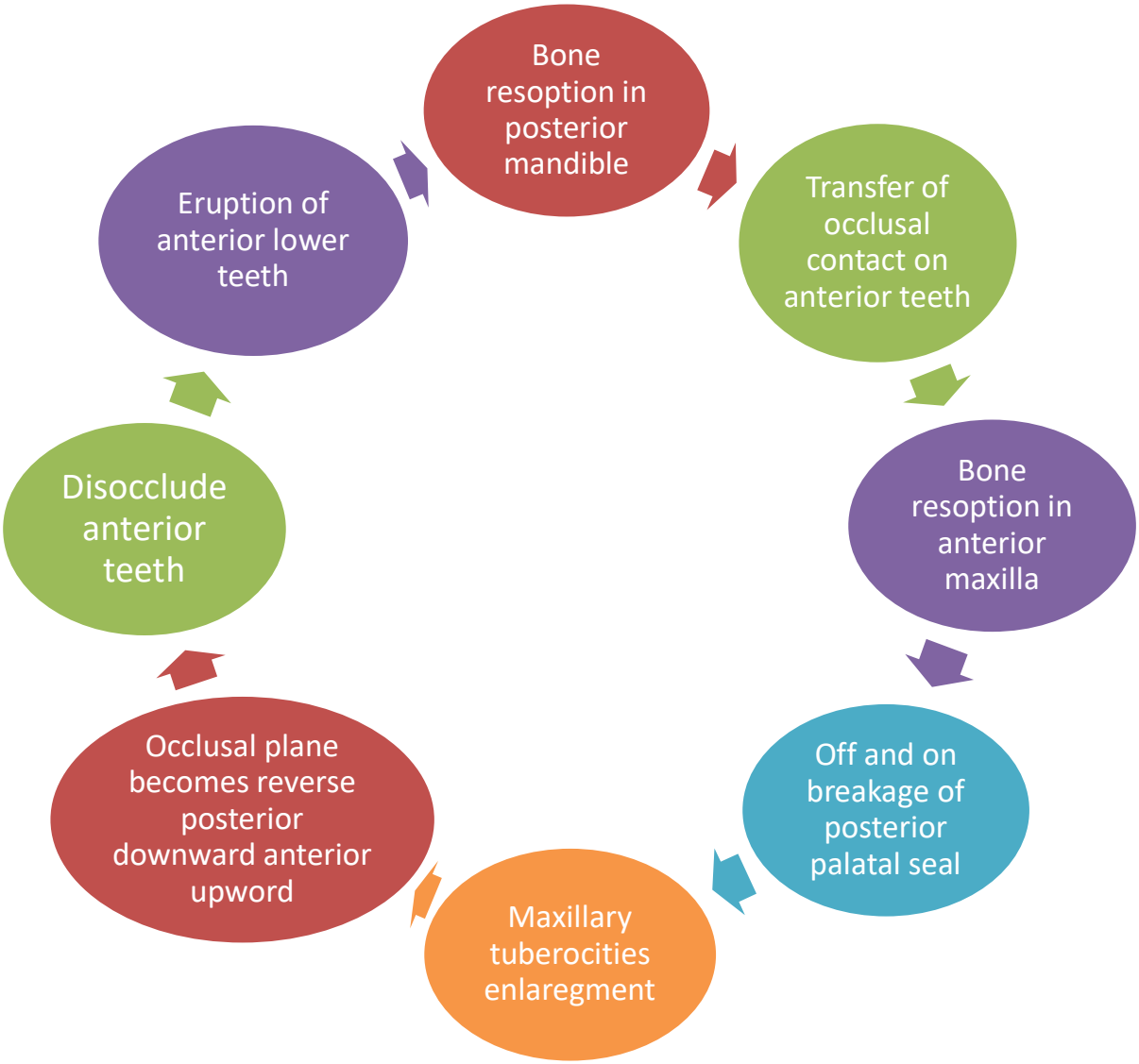


PREVENTION

It can be done by maintaining the occlusal vertical height. The vertical height can be maintained by providing metal occlusal surfaces of posterior teeth or by amalgam stops in posterior teeth.

The second step is regular relining of dentures to compensate the bone resorption.

Combination Syndrome PATHOPHYSIOLOGY


Bone resoption in posterior mandible
Transfer of occlusal contact on anterior teeth
Bone resoption in anterior maxilla
Off and on breakage of posterior palatal seal
Maxillary tuberocities enlaregment
Occlusal plane becomes reverse posterior downward anterior upword
Disocclude anterior teeth
Eruption of anterior lower teeth

PROBLEMS OF ANGLE'S CLASS II EDENTULOUS PATIENTS

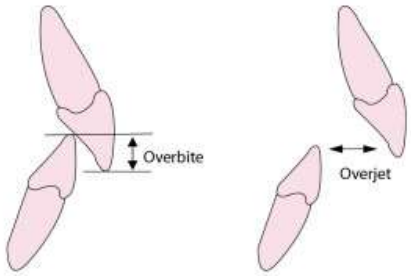
These are the most difficult patients for complete dentures. Protruded anterior maxilla vertically and horizontally limited the space for anterior flange and anterior teeth. It can be solved by making the anterior flange thin in mild cases. In moderate cases open space dentures or gum fitted dentures can solve the problem. In severe cases surgical alveolectomy in both vertical and horizontal direction is required.

other anatomical problems are V-shaped hard palate,90-degree soft palate drop,2mm post dam area. These problems compromise the retention and stability of the upper denture, but they cannot be altered. The stability can be compensated by the help of occlusion.

In these patients the mandible in premolar area are also narrow than the maxilla. It creates problem of set up of the teeth. If teeth set according to ridge it become unaesthetic due creation of a step behind canines. This problem can be solved by providing double occlusal table in denture. The inner table use for mastication and outer for esthetics.

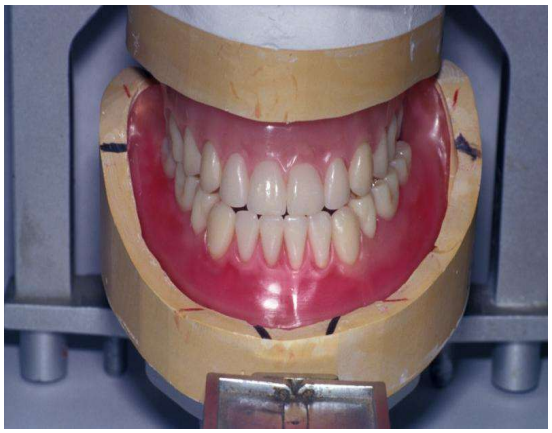
Other problem is the hyper mobile mandible with excessive horizontal translation to make edge to edge contact with upper teeth and increased free way space. It can only be solved by reducing the over bite. Never reduce over jet because in creates obstruction in the way of mandible anterior movement and dislodge the denture.

In these patients to record the centric relation also pose problem. Mono plain occlusion (zero cusp/cusp less teeth) is recommended in these cases. To make class I canine relation No. of incisors can be reduced to 3 or even 2 in severe cases.



ANGLE'S CLASS III EDENTULOUS PATIENTS

These patients have large mandible than maxilla, no anterior mandible translation and narrow freeway space. The only problem they pose is in set up of teeth. In mild cases anterior set up can be set in class I relation with 1mm over jet. In mild cases set up can be adjusted in edge to edge incisor relation. In severe cases reverse anterior guidance is created as there is no anterior translation of mandible in these patients



In posterior set up as mandible is wider than maxilla cross bite relation is created. Posterior cross bite can be created by shifting right upper teeth to left lower ridge and left lower teeth to right upper ridge and vice versa.

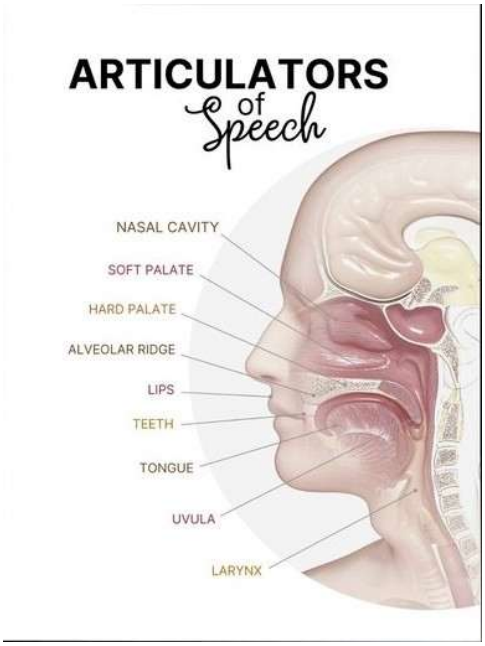
PHONETICS

The ability to communicate effectively is a fundamental aspect of human interaction, and speech plays a pivotal role in this process. While we often associate speech with the vocal cords, tongue, and mouth, one crucial component that significantly influences speech production is often overlooked is teeth. The position, alignment, and overall health of teeth can have a profound impact on how to articulate sounds and pronounce words.

It is important to understand the basic anatomy of speech production. Speech is produced through the coordinated movements of various articulatory organs, including the vocal cords, lips, tongue, palate, and teeth. Each of these components contributes to the formation of specific sounds and phonemes.
All the sounds we make when we speak are the result of muscles contracting. The muscles in the chest that are used for breathing produce the flow of air that is needed for almost all speech sounds; muscles in the larynx produce many different modifications in the flow of air from the chest to the mouth. After passing through the larynx, the air goes through the vocal tract, which ends at the mouth and nostrils. Here the air from the lungs escapes into the atmosphere. We have a large and complex set of muscles that can produce changes in the shape of the vocal tract, and in order to learn how the sounds of speech are produced it is necessary to become familiar with the different parts of the vocal tract. These different parts are called articulators, and the study of them is called articulatory phonetics.

SPEECH ARTICULATORS

The **soft palate** in a position that allows air to pass through the nose and through the mouth. The other important thing about the soft palate is that it is one of the articulators that can be touched by the tongue. When we make the sounds k, the tongue is in contact with the lower side of the soft palate, and we call these velar consonants.



The **hard palate**. A consonant made with the tongue close to the hard palate is called palatal. The sound j in ‘yes’ is palatal.

The **alveolar ridge** is between the top front teeth and the hard palate. Sounds made with the tongue touching here (such as t, d, n) are called alveolar.

The **tongue** is a very important articulator and it can be moved into many different places and different shapes. It is usual to divide the tongue into different parts, though there are no clear dividing lines within its structure.

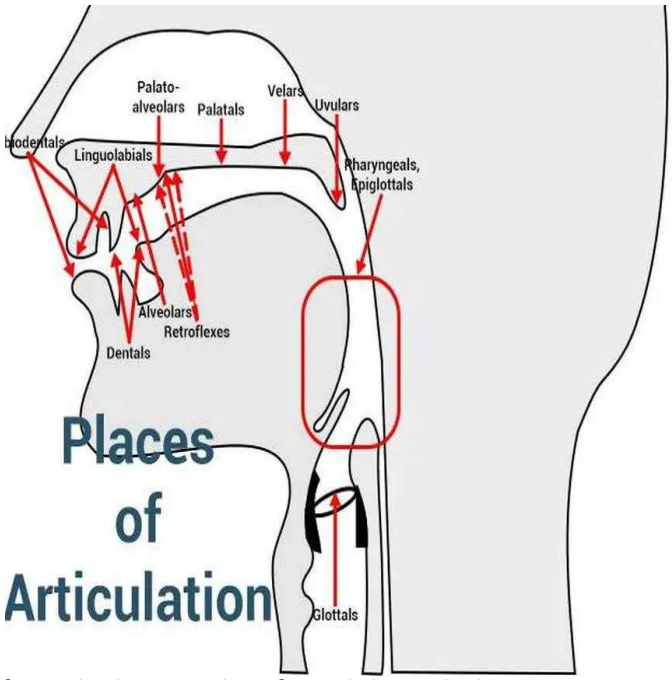
While the **teeth** may not be directly involved in the production of every sound, they play a crucial role in shaping the airflow and positioning the tongue and lips. The teeth act as a guide for the tongue and lips to produce certain sounds, Therefore, any alterations or

abnormalities in the teeth can impede the precise placement of the tongue and lips, leading to speech difficulties. The teeth and tongue are in contact with the upper side teeth for most speech sounds. Sounds made with the tongue touching the front teeth, such as "th" is called dental sounds.

The **lips** are important in speech. They can be pressed together (as in p, b), brought into contact with the teeth (as in f, v), or rounded to produce the lip-shape for vowels like u. Sounds in which the lips are in contact with each other are called bilabial, while those with lip-to-teeth contact are called labiodental.

ARTICULATION

Refers to the physical movements of the speech organs (like the tongue, lips, and jaw) to produce speech sounds. Teeth, while largely passive in this process – meaning they don't move on their own to create sound – serve as essential contact points or guides for the more active articulators, especially the tongue and lips. Without teeth, many of the sounds would be impossible to produce clearly, or at all.

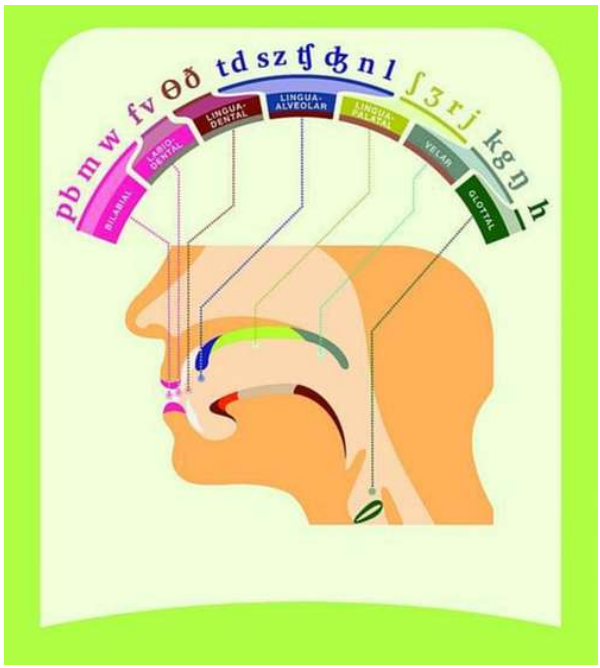


LABIODENTAL SOUNDS:

The Lip-Teeth Partnership Consider the sounds /f/ as in "fish" or "photo," and /v/ as in "voice" or "very." These are known as labiodental sounds. To make these sounds, gently bring lower lip up to meet upper front teeth (incisors). Air from the lungs is then forced through the narrow opening created between lip and teeth. The friction of the air passing through this constricted space produces the characteristic sound like "fluffy" or "vivid" without letting lower lip touch upper teeth. When this sounds become distorted, often turning into a more bilabial (two-lip) sound like /p/ or /b/, or simply a puff of air. The teeth provide a stable, hard surface for the lip to press against, allowing for precise control over the airflow and, consequently, the sound produced.
The set up of upper teeth in a prosthesis can affect these sounds. As little posterior or anterior placement of teeth can change the f sound in v sound and v sound like f, respectively.

DENTAL SOUNDS:

When tongue meets teeth another critical group of sounds produced, heavily reliant on teeth, are the dental sounds. In English, these are primarily the “th” sounds: as in “think,” “thumb,” or “path,” and as in “this,” “that,” or “mother.” To articulate these, the tip or blade of the tongue makes light contact with the back of the upper front teeth, or sometimes protrudes slightly between the upper and lower front teeth. The air is then pushed through the small channel formed between the tongue and the teeth. The precise placement of the tongue against the teeth is crucial for the distinct “th” quality. Without this dental contact, /v/ might sound more like /f/ or /s/, and /f/ might sound like /v/ or /z/. The upper incisors, in particular, act as the primary wall against which the tongue shapes these particular sounds.



ALVEOLAR SOUNDS:

Many common consonants are formed with the tongue touching or approaching the alveolar ridge. These include sounds like /t/ (top), /d/ (dog), /s/ (sun), /z/ (zoo), /n/ (nose), and /l/ (lip). While the primary contact for these sounds is the alveolar ridge, the teeth play a crucial supporting role. They form the front boundary, helping to direct the airflow and guide the tongue to the correct position.
For sibilant sounds like /s/ and /z/, the teeth are especially important. The air is channeled in a narrow stream between the tongue and the alveolar ridge, and then directed over the sharp edges of the teeth. This creates the characteristic hissing quality. If front teeth are missing or significantly misaligned, these sibilant sounds often lose their sharpness, becoming “slushy” or distorted.

Scientific understanding confirms that the precise placement of the tongue or lips against the teeth is fundamental for producing several consonant sounds. These include the labiodental sounds, where the lower lip contacts the upper teeth, and dental sounds, where the tongue interacts with the upper teeth. Without this interaction, these sounds cannot be formed correctly, impacting overall speech intelligibility. This highlights the intricate role of dental structures in the mechanics of clear communication.
The changes in dental status can have a noticeable effect on speech production. The absence of teeth, their misalignment, or even the introduction of dental appliances can alter how sounds are formed.
Losing teeth, particularly front teeth (incisors and canines), can significantly affect articulation.
For labiodental sounds (/f/, /v/), the absence of upper incisors means the lower lip has no surface to press against, making these sounds difficult to form clearly. They might sound weak or breathy.
Dental sounds also suffer, as the tongue loses its primary contact point. This can lead to substitutions, for instance, “think” might sound more like “fink” or “sink.”

The sibilant sounds (/s/, /z/) are very vulnerable. Without the front teeth to help channel the airflow, air can escape laterally or too diffusely, resulting in a lisp or a whistling sound. Even a single missing anterior tooth can create a gap that alters airflow patterns, leading to subtle but perceptible speech changes. The extent of the impact often depends on which teeth are missing and how many.

MALOCCLUSION

The misalignment of teeth and jaws (like overbites, underbites, crossbites, or open bites), can also influence speech patterns. An open bite, where the front upper and lower teeth don't meet when the mouth is closed, can make it challenging to produce /s/, /z/, /ʃ/ (sh), and /ʒ/ (as in "pleasure") sounds correctly, often leading to a lisp because the tongue may thrust forward into the gap.
A severe overjet (where upper front teeth protrude significantly) might affect labiodental sounds or cause the lower lip to work harder to achieve closure for bilabial sounds like /p/, /b/, and /m/.
An underbite (where lower teeth protrude beyond upper teeth) can impact sounds requiring the tongue tip to contact the alveolar ridge or upper teeth, potentially distorting /t/, /d/, and sibilant sounds.
The specific impact varies greatly depending on the type and severity of the malocclusion, and the individual's ability to adapt.

DENTAL RESTORATIONS AND SPEECH ADAPTATION

When teeth are replaced with dentures, bridges, or implants, speech can often be improved, especially if missing teeth were causing articulation problems. These restorations aim to re-establish the natural contact points for the tongue and lips. However, there's usually an adaptation period. New dentures, for example, might feel bulky initially, and the tongue and lips need time to get used to the new shapes and contours in the mouth. Sounds like /s/ and /th/ might be temporarily affected as the speaker learns to fine-tune their articulatory movements with the new appliance. Over time, most people adapt well, and their speech clarity can return to normal or even improve.
It's crucial to remember that teeth do not work in isolation to produce speech. They are part of a highly coordinated system involving many other structures. The tongue is arguably the most versatile articulator, capable of a vast range of movements and shapes to touch different parts of the mouth. The lips can round, spread, and close to modify sounds. The palate, comprising the hard palate and the soft palate, provides other critical contact surfaces. Airflow from the lungs, modulated by the vocal cords in the larynx to create voice, is the raw material that these articulators shape into distinct speech sounds. In this complex interplay, teeth provide stable, unyielding surfaces that allow the more mobile articulators, like the tongue and lips, to make precise contacts. They help to define the space within the oral cavity, influencing resonance and airflow direction. Without teeth, the entire dynamic of this system changes, requiring compensatory movements from other articulators, which may or may not be successful in maintaining clear speech.

TREATMENT OF PARTIALLY DENTATE PATIENT

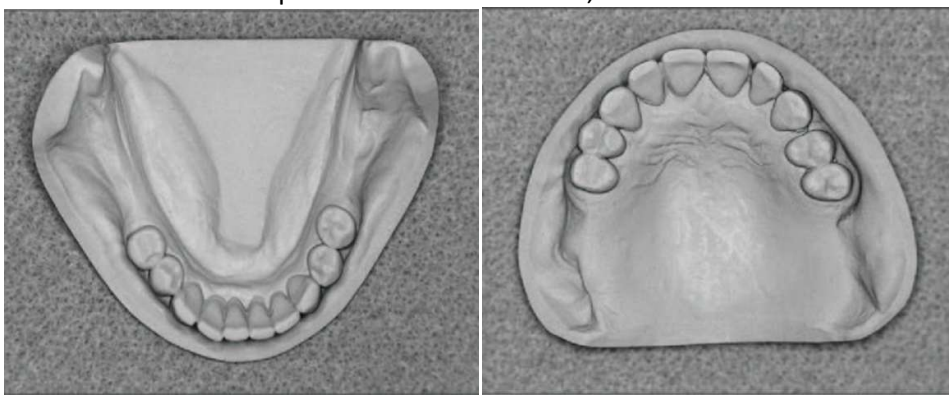
REMOVABLE PARTIAL DENTURES

CLASSIFICATION OF PARTIAL DENTURE

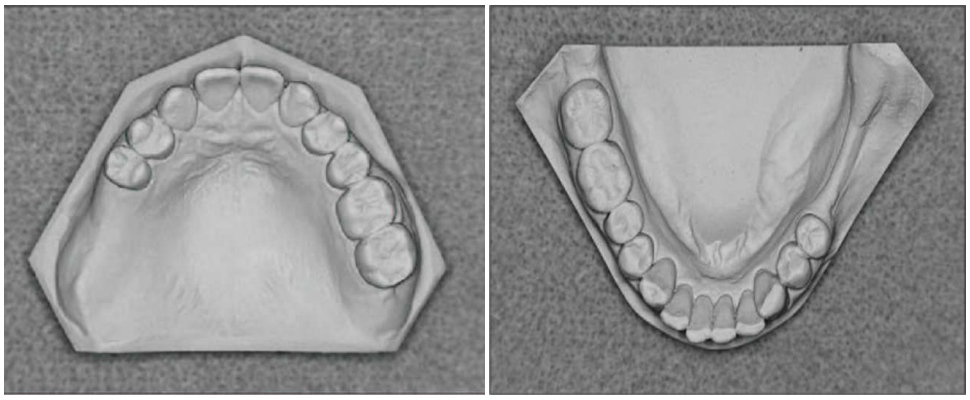
Kennedy Classification
Support Classification

KENNEDY CLASSIFICATION:

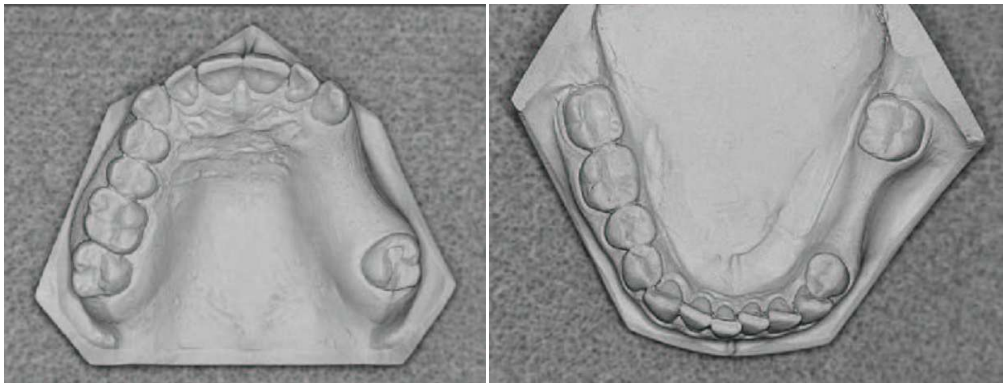
Class I: - Bilateral edentulous area posterior to natural teeth, or bilateral tree end saddle area.



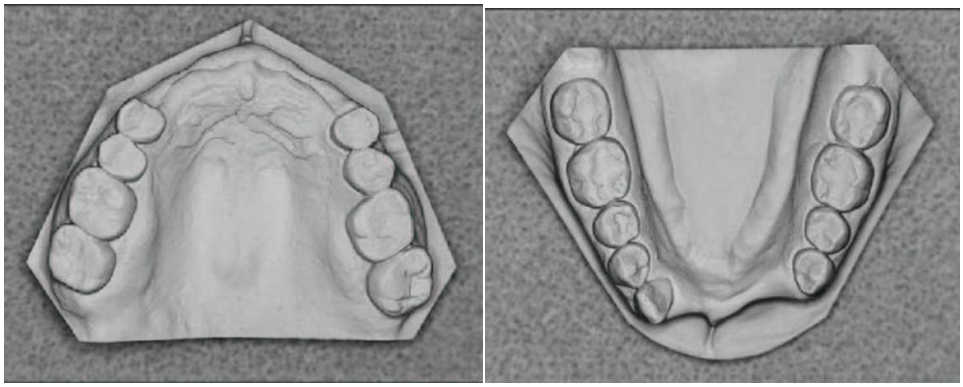
Class II: - Unilateral edentulous area posterior to natural teeth, or unilateral tree end Saddle



Class III: - Unilateral edentulous area bounded by natural teeth (anterior and posterior) or unilateral bounded saddle.

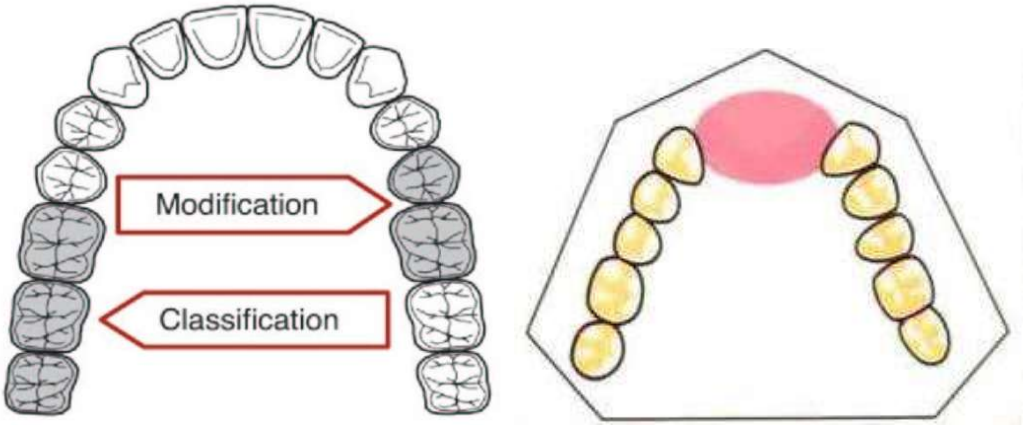


Class IV: Edentulous area anterior to the nature teeth crossing midline i.e. anterior saddle area crossing midline.



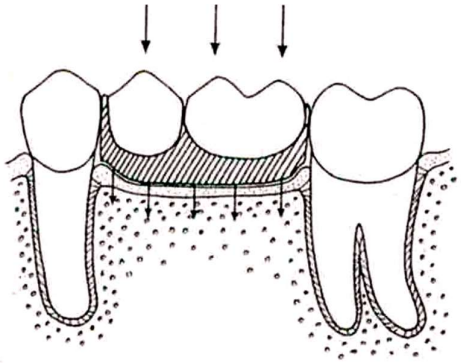
RULES FOR KENNEDY CLASSIFICATION:

1. Most posterior edentulous area determines the class
2. Teeth not going to replace e.g. third molar will not consider for classification.
3. If 2nd molar is missing and not going to replace then it will not be including in classification.
4. The classification will follow the extraction of any tooth not precede i.e. after extraction classification will consider.
5. Edentulous areas other than classification area will called modification area and Identified by their numbers as, class I modification 1, or, class I modification 2. The number of edentulous areas is considering not its span.
6. There is no modification of class IV.

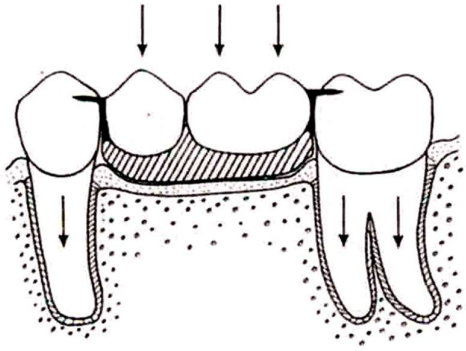


SUPPORT CLASSIFICATION:

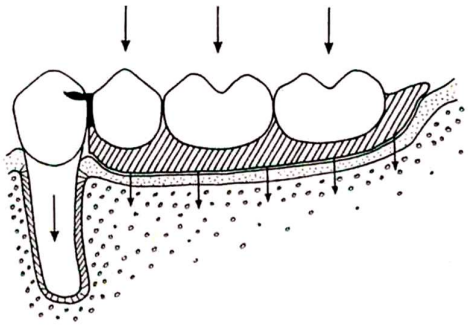
Class I: - The denture is entirely support by the abutment teeth (tooth supported denture)
Class II: - The denture is entirely supported by the mucous membrane (tissue supported denture)
Class III: - The denture is supported both by the abutment teeth and mucous membrane (tooth & tissue supported. denture)



Class I



Class II



Class III

REMOVABLE PARTIAL DENTURE (RPD)

A removable partial denture is a prosthesis, which replaces partial loss of natural teeth and associated tissues to restore function, esthetics, phonetics and can be removed by the patient.

INDICATIONS OF RPD

When posterior abutment is missing
When cross arch stabilization is required (Large saddles) i.e., one side of arch will be stabilizing from other side.
When restoration of soft and hard tissues is required (bone loss)

DISADVANTAGES

Caries
Periodontal problems
Bulk
Increase plaque index

STEPS OF RPD TREATMENT

Patient examination
Treatment planning
Surveying
Frame work design

Five steps of RPD design

Where to get Support (rest & saddle selection)
How to connect support (Major connecter selection)
Where to get Retention (Direct & indirect retainers' selection)
How to connect support & retention (minor connector selection)
Connect the saddle area to other parts

PARTS OF RPD

Major connectors
Minor connectors
Rests
Direct Retainers
Indirect Retainers
Saddles

MAJOR CONNECTORS

It is the part of the RPD that connects the saddle area to other saddle area same side or on opposite side. It is that unit of the PD to which all others parts are directly or indirectly attached.

REQUIREMENTS OF MAJOR CONNECTORS

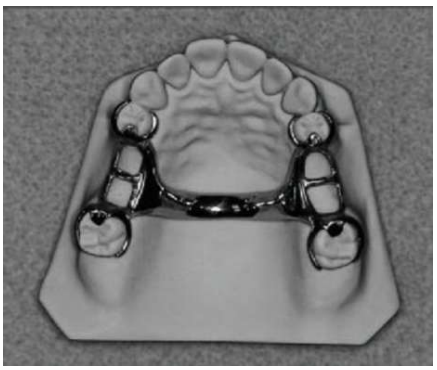
It should be Rigid
It should not interfere with tongue
It should not alter the nature contour
It should not impinge oral tissue
It should not cover more tissues then required
It should be 4-6mm away from free gingival margin (otherwise it causes gingival irritation, recession and impaired blood supply)
It should not trap food particles
It should have support from other parts
It should distribute loads to all parts

MAXILLARY MAJOR CONNECTORS: -
There are three types of maxillary major connectors depending upon the tissue coverage
PALATAL BAR
The bar is less than 8mm in width so for proper strength the thickness should be increased. The bars may be anterior middle or posterior according to the position of the edentulous areas.

PALATAL STRAP
A strap is more than 8mm in width so it is strong in thin section.
The strap also is anterior, middle or posterior according to the position of the edentulous area

PALATAL PLATE
A palatal plate major connector should cover the whole palate or 2/3 of the palate.

SELECTION OF MAJOR CONNECTORS
The selection of maxillary major connector depends upon the following factors
Type of Edentulous Area (free end or bounded saddles)
Size of Edentulous Area
Torus presence
Abutment Support (good or poor)
Residual Ridges (good or resorbed)
SINGLE PALATAL BAR
INDICATIONS
Bilateral edentulous area of short span in tooth supported dentures class III in middle of the hard palate where it cannot disturb tongue function. Its thickness can disturb tongue function and it width transfer load on small area.



PALATAL STRAP MAJOR CONNECTOR

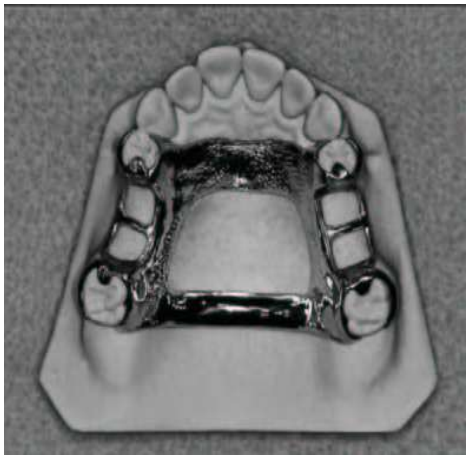
INDICATIONS

Short Span, Tooth Supported, Bilateral Edentulous Area

ADVANTAGES

Anatomical Replica
Better load distribution

ANTERIOR POSTERIOR BAR



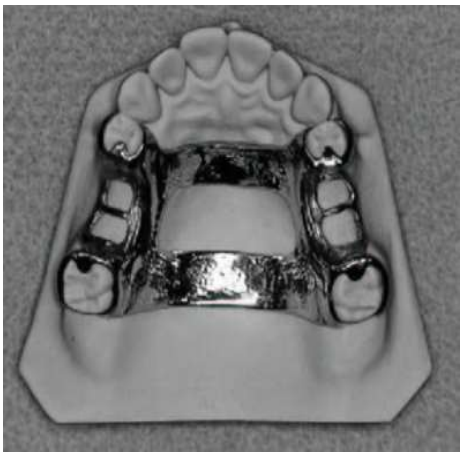
INDICATIONS

Kennedy's Class I and II arches
Kennedy's Class III with large edentulous area with modification
Kennedy's Class IV
Good abutment support
Good ridges
Inoperable small tori

ADVANTAGES

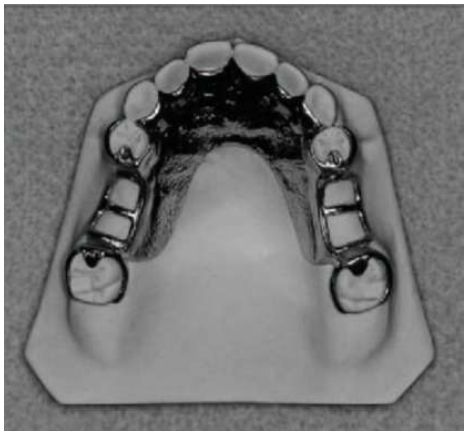
Most rigid design with good stress distribution

There is different design can be made with combination of anterior bar and posterior strap, anterior strap posterior bar, anterior posterior bar, anterior posterior strap. All it depends upon the space available for placement of bar or strap. The presence of tori limits the space available for major connector. Where more space in available anterior we can give anterior strap and where more space is available posterior to the tori and soft plate, we can give posterior strap.



U SHAPED MAJOR CONNECTOR

This type of major connector is least desirable because of its open-end design which creates flexibility in it. It also has poor design in reference to support and stress distribution. A large size of tori which extends to the soft palate is the only indication of this design. Whenever possible a posterior bar may be added to closed its open end and increase it rigidity.



MAJOR CONNECTORS MAXILLA

MAJOR CONNECTOR	FACTORS FOR SELECTION			
	TYPE OF EDENTULOUS AREA	SIZE OF EDENTULOUS AREA	TORUS	ABUTMENT TEETH RESIDUAL RIDGE
Palatal bar	Bounded bilateral tooth supported	Small	Absent	Very good
Palatal strip	Bounded bilateral tooth supported good height	Medium	Absent	Very good
Bar/strap combination	Bounded bilateral tooth supported good height	Large	May be present of small size	Good
Palatal plate partial	Fee end saddles unilateral or bi lateral Kennedy class I & II good ridges	Medium	Absent	Good
Palatal plate complete	Fee end saddles unilateral or bi lateral Kennedy class I & II poor ridges	Large	Absent	Weak
U-shaped	Fee end saddles unilateral or bi lateral Kennedy class I & II poor ridges	Large	Medium to large size which cannot be encircle by combination of bar & strips.	Good to weak

PALATAL PLATE MAJOR CONNECTOR

In cases where the more tissue coverage is required for stress distribution and for support because of loss of most of posterior teeth palatal plate major connectors are indicated. It is of two types according to the palatal coverage.

PARTIAL PALATAL PLATE MAJOR CONNECTOR

It covers more than half of hard palate.

INDICATIONS

Kennedy's Class I Arches with weak ridges and Strong abutments.

COMPLETE PALATAL PLATE MAJOR CONNECTOR

It covers the complete hard palate.

INDICATIONS

In Large Kennedy's Class I with poor Abutments and ridges
In Kennedy's Class II with large posterior modification area

MANDIBULAR MAJOR CONNECTORS: -

TYPES

1. Lingual Bar
2. Sublingual Bar
3. Linguoplate
4. Cingulum Bar
5. Kennedy Clasp
6. Labial/Buccal Bar
7. Swing lock

SELECTION OF MAJOR CONNECTORS

The selection of mandible major connector depends upon following factors.
Distance between Free Gingival Margin and Floor of Mouth
Lingual Frenum attachment
Inclination of anterior teeth
Bony Undercuts and tori
Spacing in Teeth
Residual Ridge quality

Distance between Free Gingival Margin and Floor of Mouth

There should be at least 8mm of distance is required between the free gingival margin of anterior teeth and elevated floor of mouth. The major connector should be 4mm away from the free gingival margin to maintain it health and the width of bar is 4mm at least is required.

How to measure

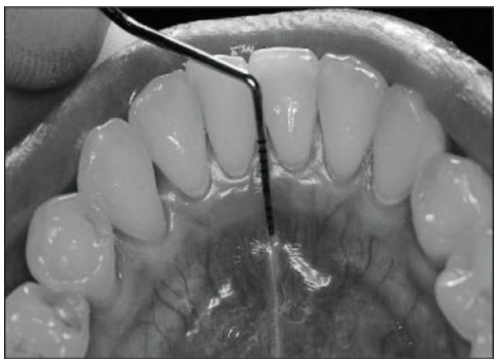
Probe method

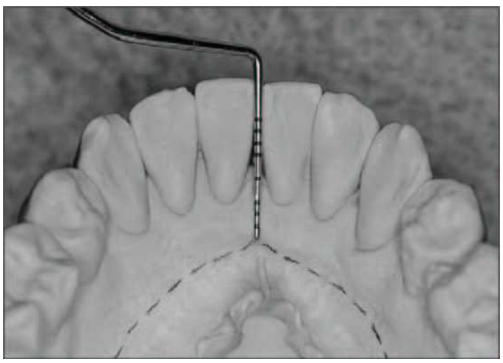
The distance between free gingival margin and floor of the mouth can be checked by measuring the depth with the help of perio prob. First ask the patient to touch the soft palate with the tongue this will elevate the floor of mouth to its functional depth. With the help of perio-probe measured the distance from free gingival margin of central incisor to the

depth of the floor of the mouth. Transfer this measurement to the patient's model of teeth. Measured the distance on all anterior teeth and transfer it to model. Now join the line on model and measure the distance on the model.

Tray method

The impression tray should be making short from the lingual frenum about 3-4mm and then a functional impression of the sulcus should be recorded with the help of low fussing compo (green stick).

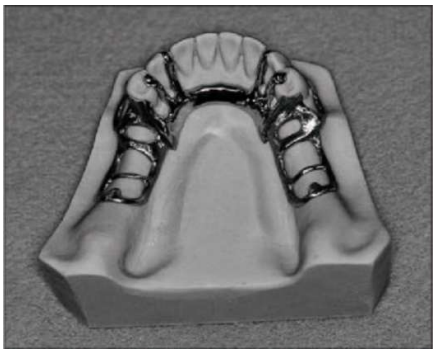




LINGUAL BAR: -

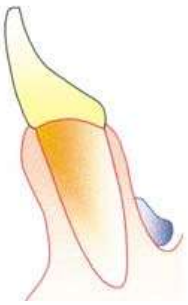
It is located above the floor of mouth but below the gingival margins at least 4mm in contact with the mucosa of the lingual side of anterior part of mandible. It is most suitable connectors. It is used where sufficient space more then 8mm is available between the gingival margins and floor of mouth.

It is half pear shaped i.e., flat on tissue side taper superiorly bulkiest at inferior third. Its upper boarder is 4mm away from free gingival margin.



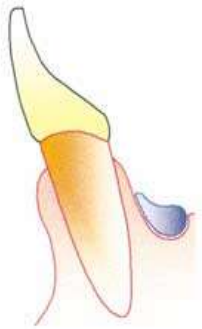
INDICATION

8mm distance between floor of mouth & free gingival margin
Normal alignment of teeth
Non bony undercuts
Good abutments
Good ridges



SUB-LINGUAL BAR: -

It is indicated where less space available for a lingual bar and all other factors are good as required for lingual bar. It is placed over and parallel to the floor of mouth. There is space between the lingual side of the anterior mandible and sub-lingual bar.



CONTINUOUS CLASP /CINGULUM BAR

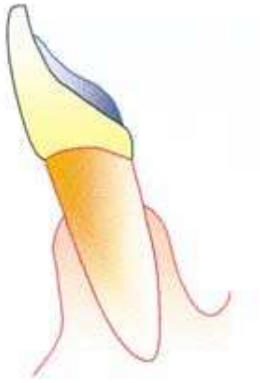
It is located in the middle third of the anterior teeth just above the cingula of teeth. It is also called continuous clasp or cingulum bar.

It is a thin narrow (3mm) metal strap located on or slightly above the cingula of anterior teeth. Its upper boarder is scalloped. Its superior & inferior borders tapered to tooth surface. It should be supported on both ends by means of rests on principal abutments.

It is contraindicated where anterior teeth are severely tilted towards lingual or labial.

INDICATIONS

Alignment of anterior teeth required excess block out
Anterior diastema
High lingual frenum attachment
Lingual undercuts
Good abutments
Good ridges

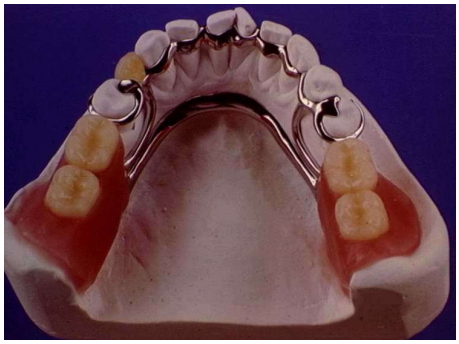


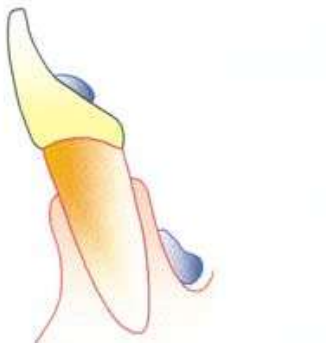
Lingual Bar Continuous Bar Combination (Kennedy Clasp)

It is the combination of cingulum bar on teeth and small lingual bar due to less space for a proper lingual bar. It has better quality of stress distribution and rigidity than continuous bar.

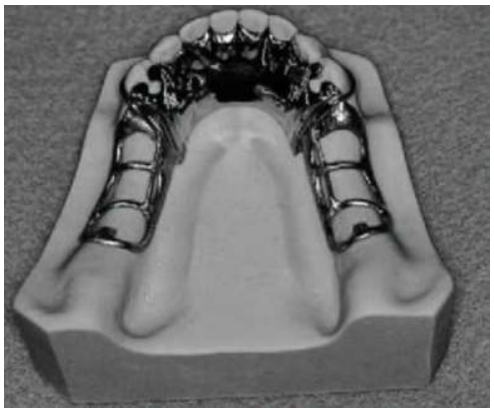
INDICATIONS

Alignment of anterior teeth required excess block out
Anterior diastema
Low lingual frenum attachment





LINGUOPLATE:



It covers the lingual surface of both anterior teeth and alveolar process. The upper border of this plate should not be extent above the middle third of the anterior teeth. Linguoplate is a result of filling in the rectangular space between lingual bar & cingulum bar.

Its Inferior boarder should be half pear shaped and bulkiest.

Its Superior boarder should be at cingulum of teeth and at contact point.

Its Superior boarder should be scalloped.

INDICATIONS

Little space between free gingival margin & floor of mouth i.e. less than 8mm

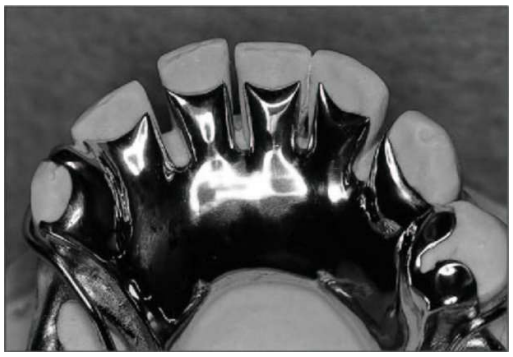
High lingual frenum attachment

Class I with resorb residual ridges because its terminal ends provide indirect retention against the fulcrum movement of denture.

Splinting of anterior teeth required due perio problems

Future replacement of anterior teeth is indicated because new teeth can be added in existing lingo plate.

INTERRUPTED LINGUOPLATE:



It is modified form of lingual plate. It is indicated where spacing exist in anterior teeth or a wide diastema present creates unesthetic appearance by show off metal between teeth.

Wide diastemas between incisors prevent the use of any major connector except sublingual bar which cannot be given due to other reasons.

LABIAL/BUCCAL BAR

It is given on the labial side rather than on lingual side. Its characteristics are

Half pear shaped with bulkiest portion inferiorly located.

Superior border tapered to tissues.

Superior border located at least 4mm away to labial gingival margins to keep gingiva healthy.

Lower margin is located at the junction of attached & unattached mucosa.

INDICATIONS

Lingual inclination of incisors & premolar

Tori

Lingual Undercuts

MAJOR CONNECTORS MANDIBLE

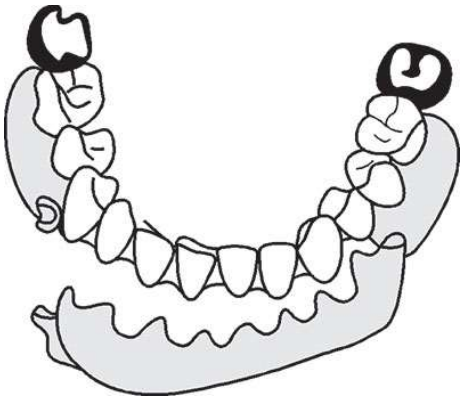
MAJOR CONNECTOR	DISTANCE B/T FREE GINGIVAL MARGIN & FLOOR OF THE MOUTH	LINGUAL FRENUM ATTACHMENT	ALIGNMENT OF ANTERIOR TEETH.	BONY UNDERCUTS AND TORI	QUALITY OF RESIDUAL RIDGE & ABUTMENT TEETH
Lingual bar	8mm or more	Normal /low	Normal straight	Absent	Good
Sub lingual bar	8mm or more	Heigh then normal	Normal straight	Absent	Good
Cingulum bar	Less than 8mm	Heigh	Crowding	Lingual undercuts	Good
Kennedy clasp	Less than 8mm	Low	Crowding	Lingual undercuts	Good
Labial/buccal bar	No influence	No influence	Lingual inclined incisors and premolars	Lingual undercuts/tori	No influence
Lingual plate	Less than 6mm	Normal	Normal straight	Absent	Resorb ridges or poor abutments
Swing lock	No influence	No influence	Labial inclined	No influence	Missing key abutment

SWING-LOCK DESIGN:

It is an unconventional design with limited use. Its characteristics are Hinged continuous labial bar. Labial bar is connected by hinge at one end & a latch on the other end.

Multiple rests on remaining natural teeth for support

Bar type retentive clasps arms projecting from bar contacting the infra bulge area for retention.



INDICATIONS

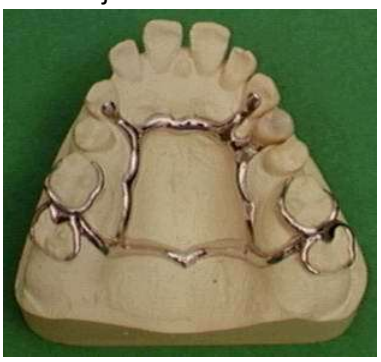
Missing key abutments as premolar and canines
Unfavorable tooth contours
Unfavorable soft tissue contours
Teeth with questionable prognoses

CONTRAINDICATIONS:

Poor oral hygiene
Lack of motivation for plaque control
Shallow labial or buccal vestibule
High labial frenum attachment

MINOR CONNECTORS

The minor connectors unite the other parts of partial denture with major connector.



FUNCTIONS

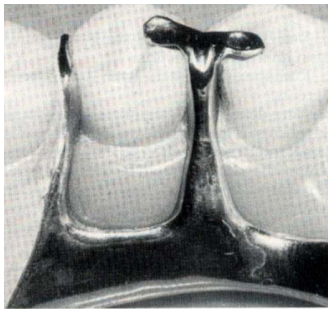
To transfer the functional stress to the abutment teeth
Help the prostheses to function as a unit
It attaches the teeth with metallic part

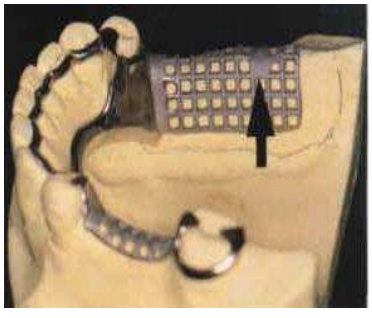
PROPERTIES

Should be RIGID
Should not change the contours
Should be located in embrasure space
Should make a right angle with major connectors

TYPES

It depends upon the which part they connect with major connector
Connect the rest
Connect the clasp
Connect the teeth
Modified minor connector as proximal plates





REST

Any unit of partial denture that rests on a tooth surface to provide vertical support is called Rest. According to their position it may be occlusal rest, cingulum rest or incisal rest.

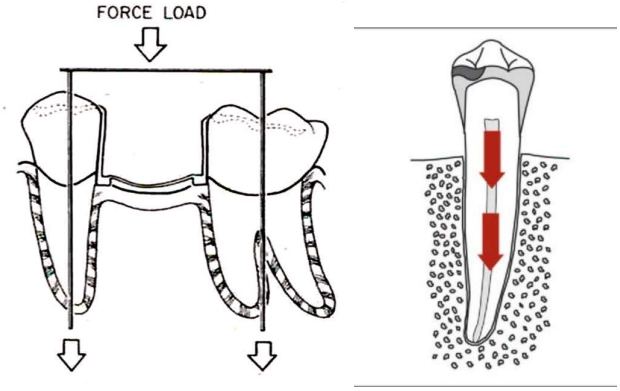
REST SEAT

The prepared tooth surface which receives the rest is called rest seat

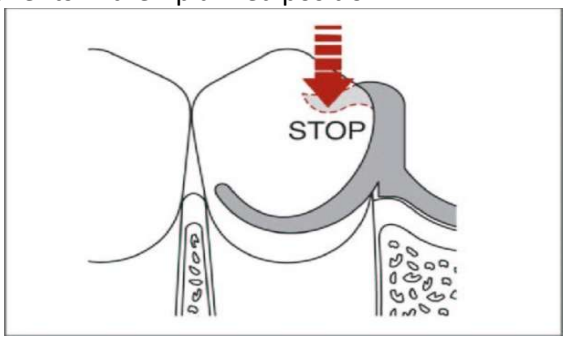
FUNCTIONS OF REST

Provide vertical support i.e. prevent tissue ward movements of denture.
Direct and distributes occlusal loads to abutment teeth
Maintain components in their planned position
Maintain and established occlusal relation
Prevents impingement of soft tissues
It indicates that the denture base needs relining as during function denture sinks and rest lift from the rest seat.

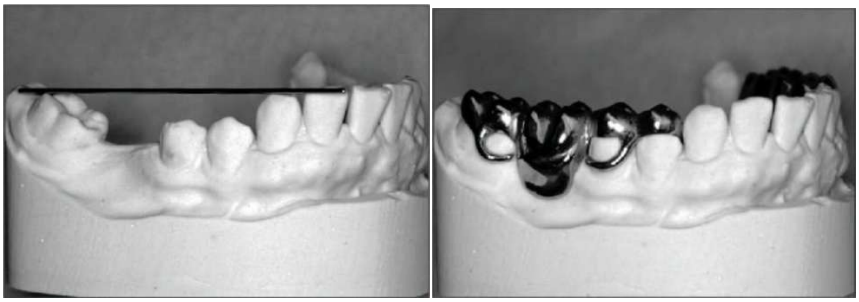
Direct and distributes occlusal loads to abutment teeth

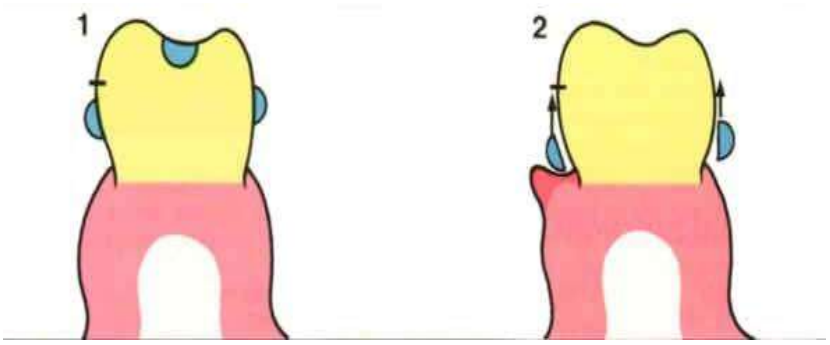


Maintain components in their planned position



Maintain and established occlusal relation





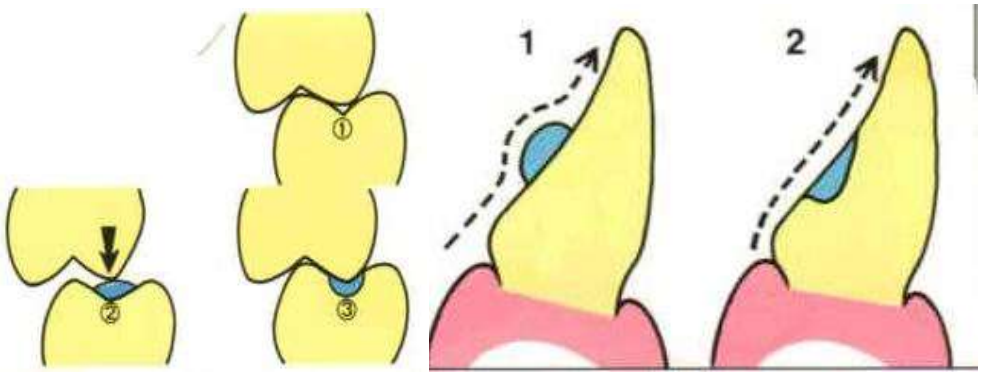
Prevents impingement of soft tissues

REQUIREMENTS

Rest must be Rigid

It should receive positive support from abutment teeth i.e. should be on prepared rest seat.

It should not interfere in occlusion



It should not interfere in occlusal

TYPES OF REST

It depends upon the surface of tooth which receives rest

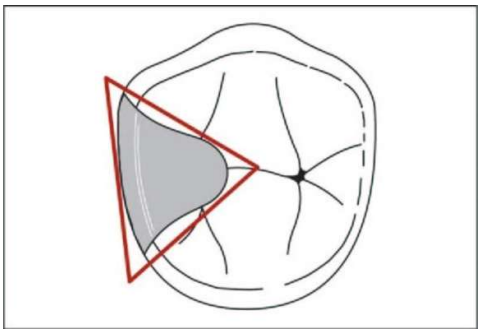
Occlusal rest

Cingulum rest

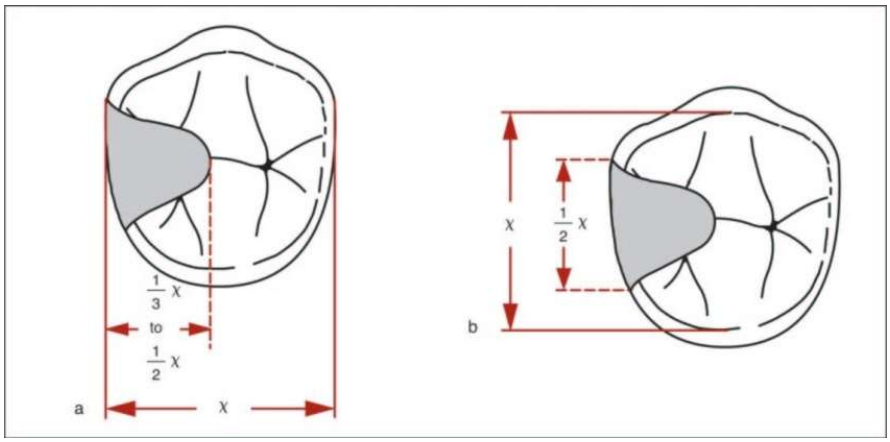
Incisal rest

OCCLUSAL REST SEAT REQUIRMENTS

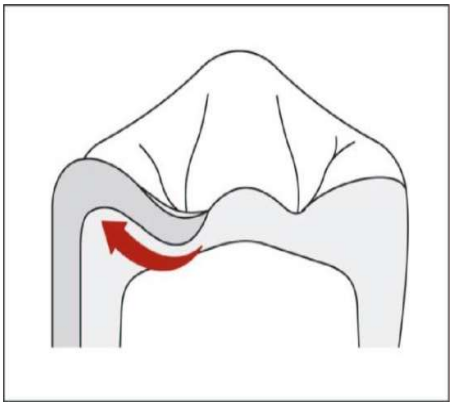
It should be rounded triangular in shaped to direct load on the long axis of the tooth.



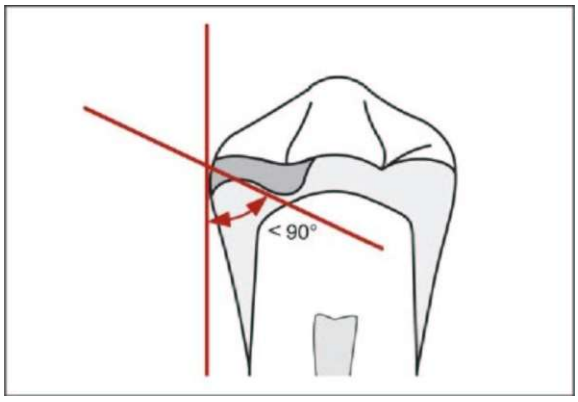
It should be as long as wide (2-2.5mm &1-1.5mm)

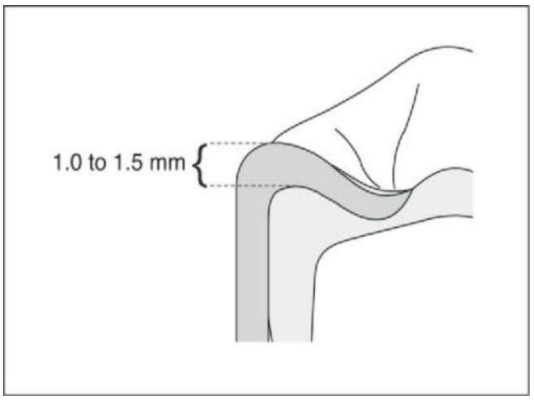


It should be spoon shaped has no sharp angles otherwise results in stress concentration and breakage.



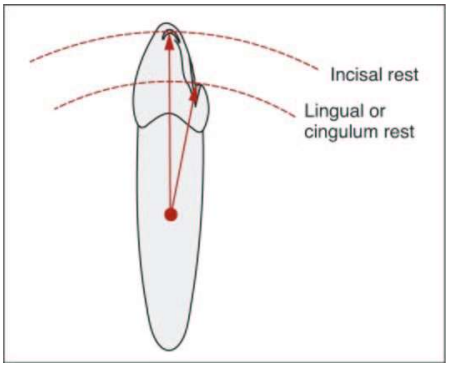
Its angle with the tooth should be less than 90 so it can transfer occlusal load towards the long axis of the tooth.
Its depth at marginal ridge should be 1-1.5 mm to have adequate thickness of metal at the junction of minor connector and rest otherwise it will fracture.



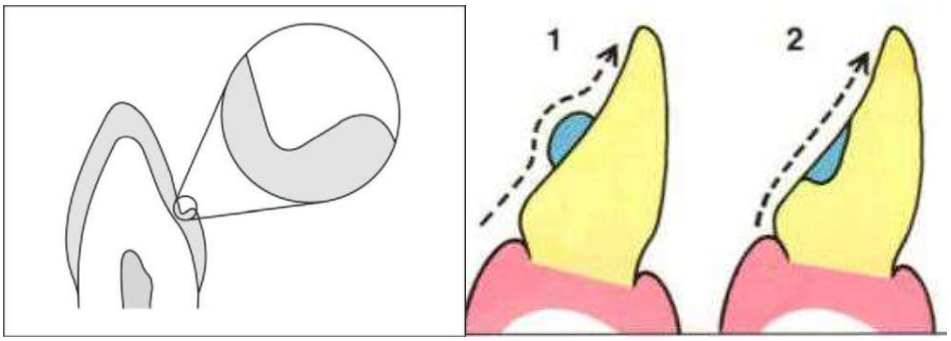


CINGULUM REST

It is placed at the junction of gingival & middle third on the lingual surface of anterior teeth, mostly on canines, at the cingulum
It floor should face towards the cingulum of tooth so it can transfer occlusal load towards the long axis of the tooth.



Its rest seat should have gradual lingual inclines. It should be rounded V shaped and tip of V pointed towards the long axis of the tooth. The seat should be within the enamel. It should accommodate the rest so it cannot interfere in occlusion.

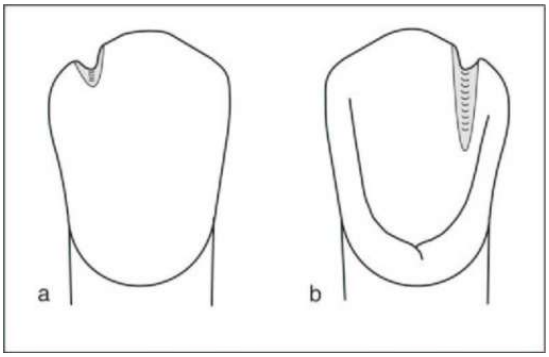


INCISAL REST

It is given on the incisal edges of the anterior teeth when no other posterior teeth remained. It is least desirable because the thinness of incisal edges and direction of transfer of occlusal load. These rests can also act as indirect retainers.

INCISAL REST SEAT

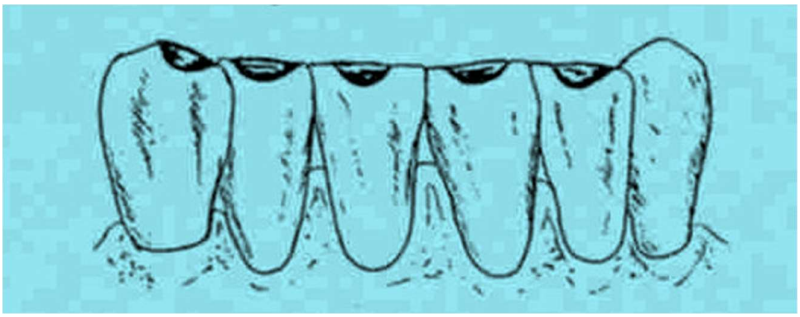
The incisal rest seat should be notched shaped. Its margins should be beveled so accommodate thickness of rests. The seat should be 2.5mm wide and 1.5mm deep.



Labial lingual

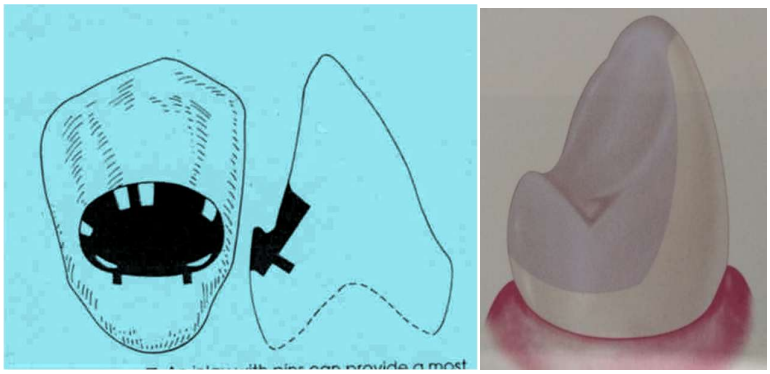
FULL INCISAL REST

It is indicated where the restoration of anterior guidance is required. It is also helpful in transfer of occlusal load on all anterior teeth.



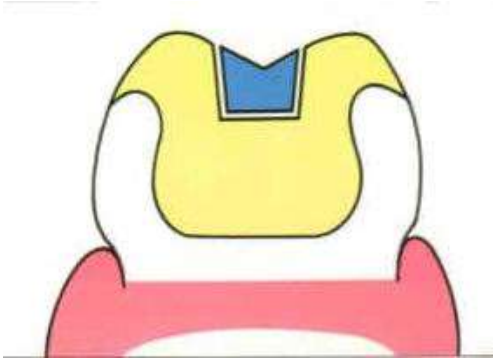
REST SEATS IN CAST RESTORATIONS

Rest seats can also be prepared in restoration as
Full crowns
Three quarter cro wn
Inlay and Onlay
Composite restorations



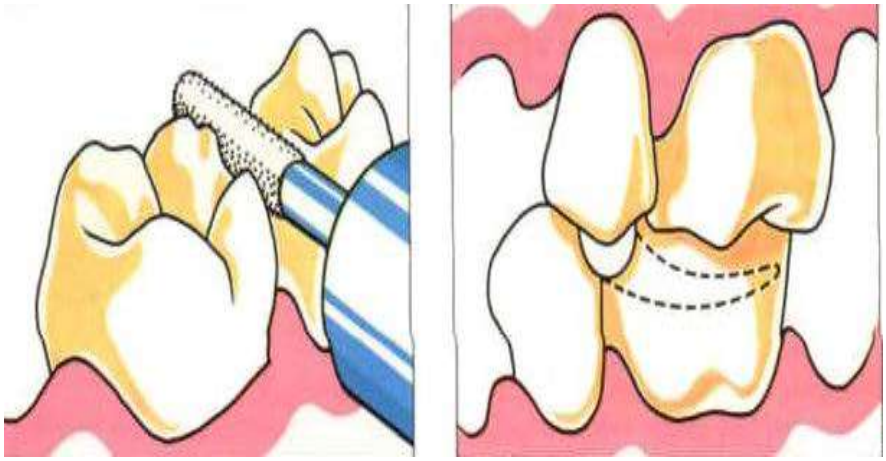
INTER OCCLUSAL REST

These typed of rest can give on the occlusal surfaces of posterior teeth. They are box, square, shaped with straight walls and flat floor. They not only support but also retention and stabilization to dentures. They are only given in tooth supported dentures with good abutments.



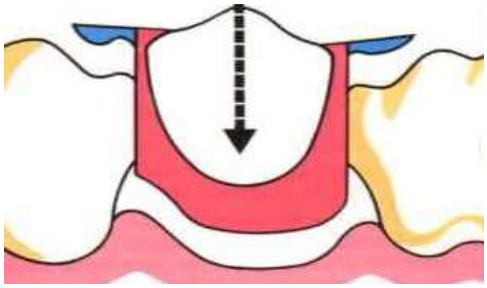
INTER PROXIMAL OCCLUSAL REST

This type of rest is given between the two teeth. It is mostly given on the opposing side of the arch to get support and retention for denture.



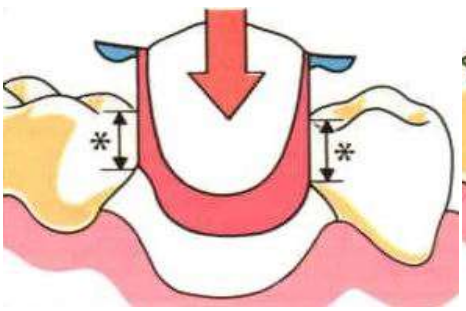
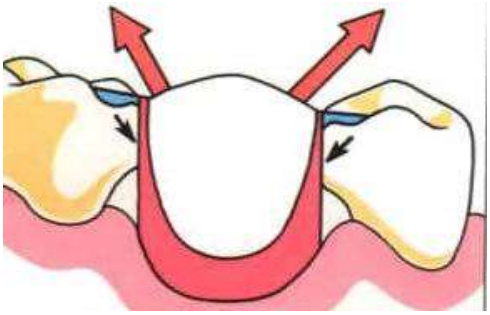
GUIDE PLANES

Guide planes are two or more parallel surfaces of abutment teeth so shaped to direct a RPD during placement and removal.

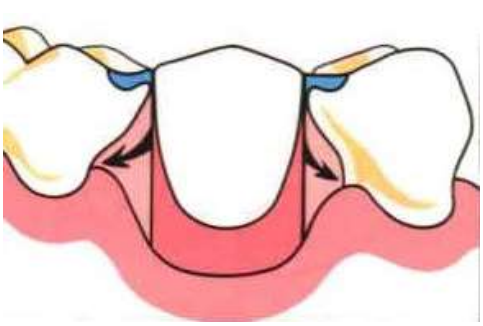
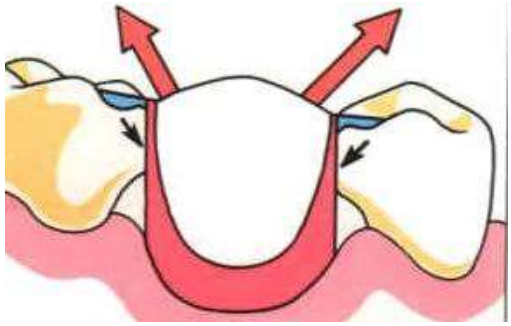


FUNCTIONS

It provides path of insertion and removal so denture can be removing in one direction.
It helps retainers for proper function

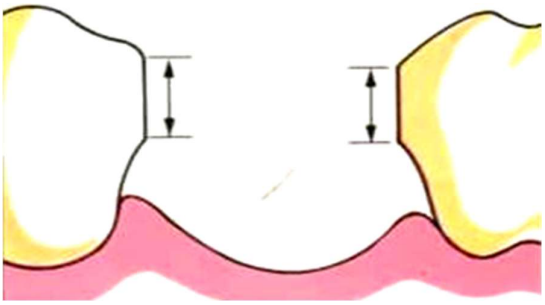
It also eliminates food traps

Food traps Reduce size of traps

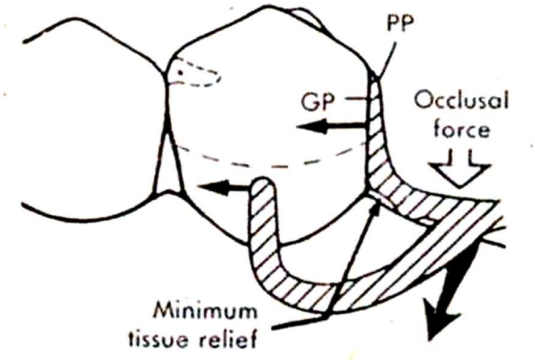
REQUIREMENTS

Their width should be 1/3 of buccal lingual width
Their length should be 2/3 length of clinical crown
To avoid creating line angles margins should be founded
Should face each other on abutment surfaces adjacent to edentulous area



PROXIMAL PLATE

That part of RPD which comes in contact with guide plane is called proximal plate. It is a modified minor connector.



PP Proximal Plate

Function

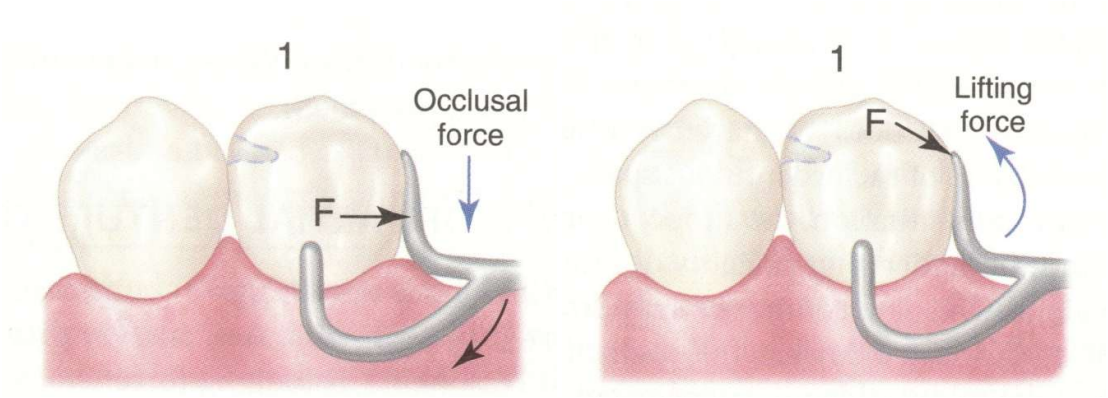
It provides path of insertion
It also provides retention
It distributes load to teeth & ridges
It joins occlusal rest with major connector

TYPES

Types are according to the contact with abutment tooth.

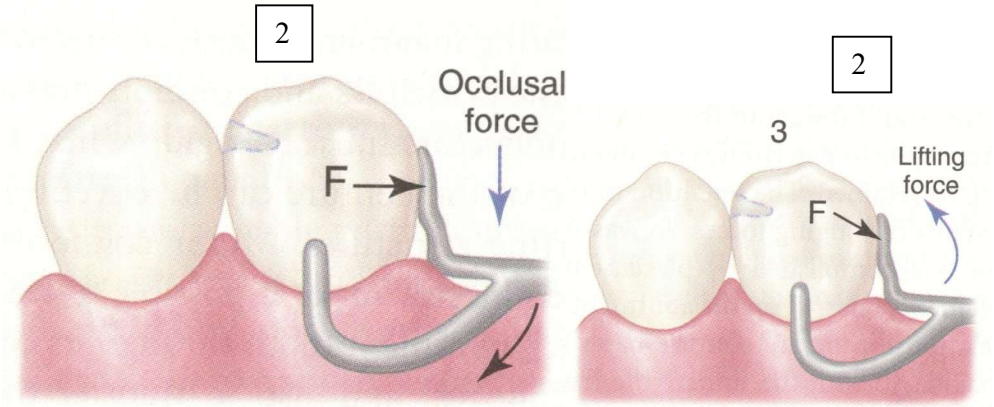
FULL LENGTH CONTACT

This proximal plate contacts the abutment tooth from marginal ridge to free gingival margin. It is indicated where the abutment teeth are strong and ridges are weak and planning is to transfer load to the teeth rather than ridges.



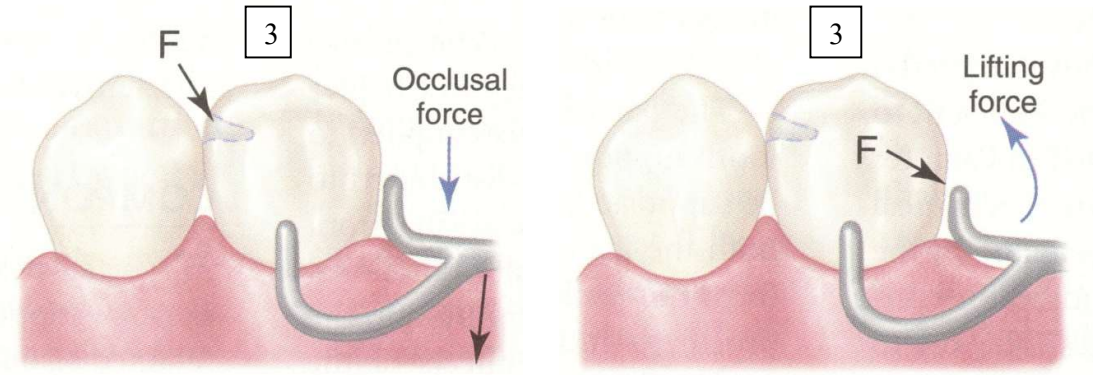
2/3 CONTACT

This proximal plate contacts the abutment tooth from marginal ridge to 2/3 of abutment length. It is indicated where the abutment teeth and ridges are of same quality and planning is to transfer load to the teeth and ridges equally.



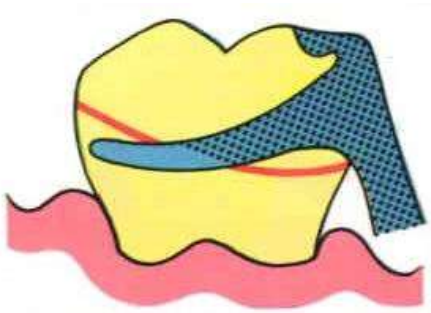
POINT (1MM) CONTACT

This proximal plate contacts the abutment tooth only at one point of 1mm. It is indicated where the abutment teeth are weak and ridges are of good quality and planning is to transfer load to the ridges. When load is applied on the denture it will disengage the tooth and transfer all load to the ridges.



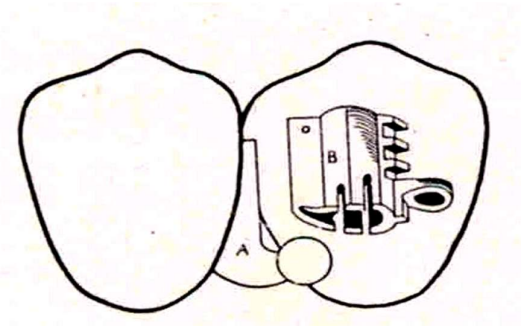
DIRECT RETAINERS

A direct retainer is a unit of partial denture that engages an abutment tooth in such a manner as to resist displacement of the denture away from the basal seat. It provides retention to the RPD retention in RPD can be



PRIMARY RETENSION:
It is mechanical and by means of providing direct retainers on the abutments

SECONDARY RETENSION:
It is by the intimate contact of the major connector with the underlying tissue and by the minor connector in contact with guiding planes.



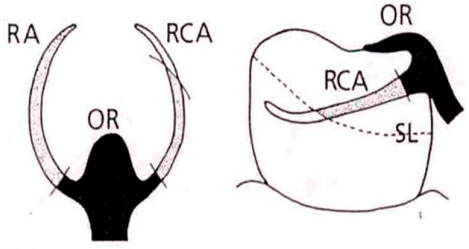
MECHANICAL RETENTION
It can be achieved by
Friction
Engaging a depression on abutment
Engaging a undercut on abutment

TYPES OF RETAINERS

1. INTRA CORONAL
They are cast or attach inside tooth e.g. key and keyway with opposing parallel vertical walls to resist displacement. They are also called precision attachments
2. EXTRA CORONAL
They are placed outside the tooth e.g. clasps

CLASPS

Clasps are used as direct retainers in most RPD. The clasp has two arms Retentive and Reciprocating arm and a body.

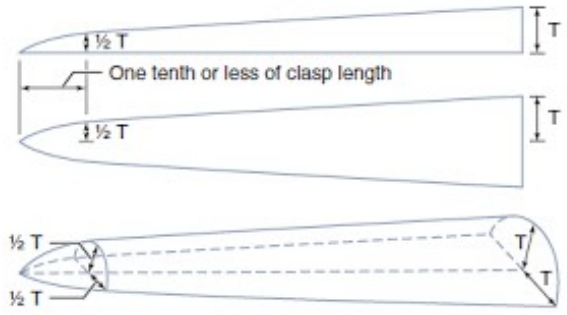


RETENTIVE ARM
Retentive arm is flexible part of the clasp. Its terminal end engages an undercut area on the buccal or lingual surface of the tooth and provides retention. The shape of retentive arm become tapering in both length and thickness as it moves from body towards undercut area. This character of its shape gives flexibility to it tip which provide retention to RPD. It is placed in the gingival third, not above the maximum bulge area.
RECIPROCAL ARM
The reciprocating arm is rigid part of the clasp and place above or at the maximum bulge area if placed in undercut it will break or cause harmful forces to the tooth. It balances the

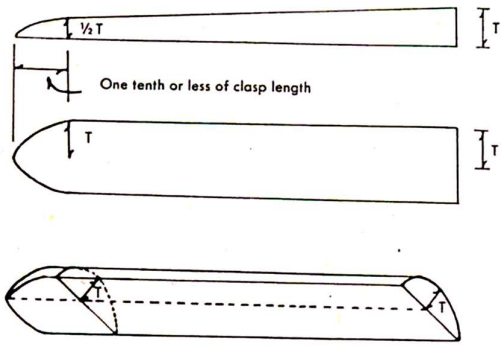
displacing forcing of the retentive arm on the abutment tooth during placement and removal of denture. It may be on the buccal or lingual side of the abutment tooth. The shape of reciprocal arm show tapering in its thickness and maintains it width same as it moves towards it tip. This shape gives it the rigidity for stabilization.

BODY

It is the modified minor connector. It unites the both arm and major connector.



Shape of retentive arm



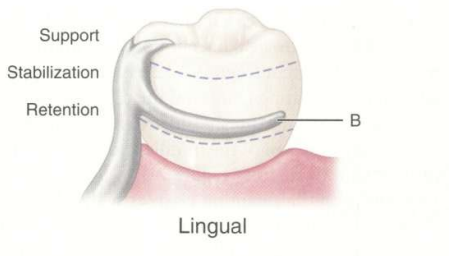
Shape of reciprocating arm

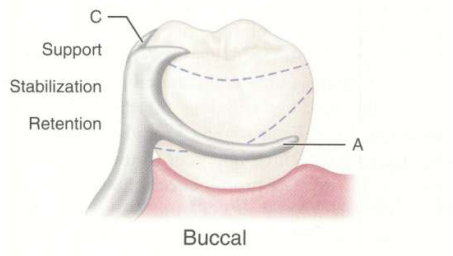
TYPES OF CLASPS

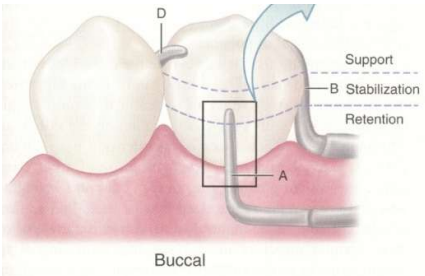
There are two types of clasps.

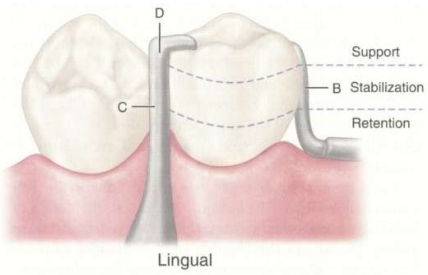
1. Gingival approaching clasp or bar clasp.
2. Occlusal approaching clasp or circumferential clasp.

The Gingival approaching clasp engages the undercut area from the gingival side of the tooth.
The Occlusal approaching clasp engages the undercut area from the occlusal direction.
The selection of the clasp depends upon the presence and location of under cuts on abutment tooth.



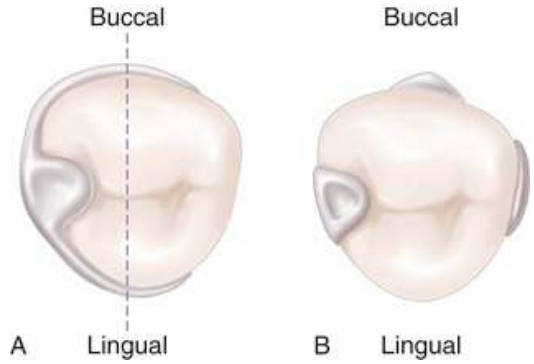




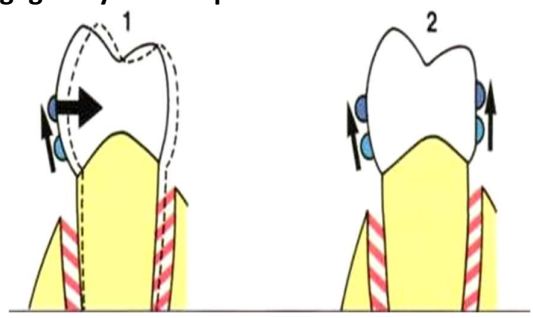


PRINCIPLES OF CLASP DESIGN

More than 180^0 of tooth circumference included
At least three-point contacts embrace more than half of crown
Retentive arm opposed by reciprocal arm
Bilaterally opposed
Only resist reasonable dislodging forces
Be passive at rest
Flexible in Class I
Have different path of escapement to that of denture
Occlusal rest must be designed to prevent cervical movement of the clasps

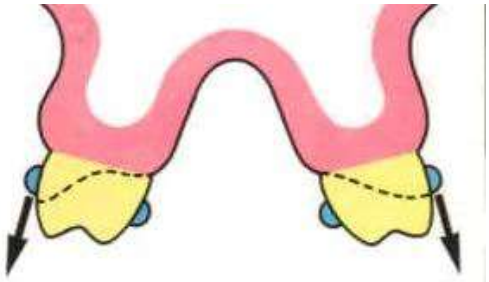


More than 180^0 of tooth circumference should be engaged by the clasps. It means that the arms of clasps should be encircled the tooth more than half of its circumference. Otherwise, tooth will be forced away from the clasp and denture will be displaced.

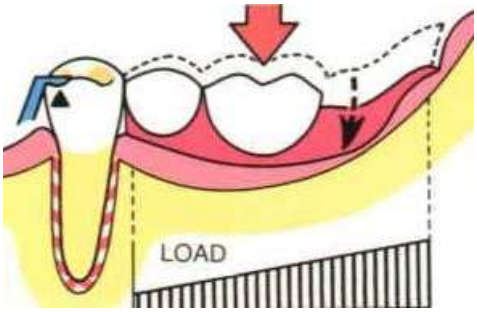


At least three-point contacts embrace more than half of crown. This is the same rule as above but applicable on gingival approaching clasps. One point is tip of bar, 2nd is reciprocating arm and 3rd is rest or proximal plate.

Retentive arm opposed by reciprocal arm: It will resist the pressure exerted by the retentive arm during placement and the removal of the denture and stabilize the abutment tooth. Without this the retentive arm lost its flexibility and denture moves away from its path of insertion. It also causes the orthodontic movements in the abutment tooth by pressing from one side.

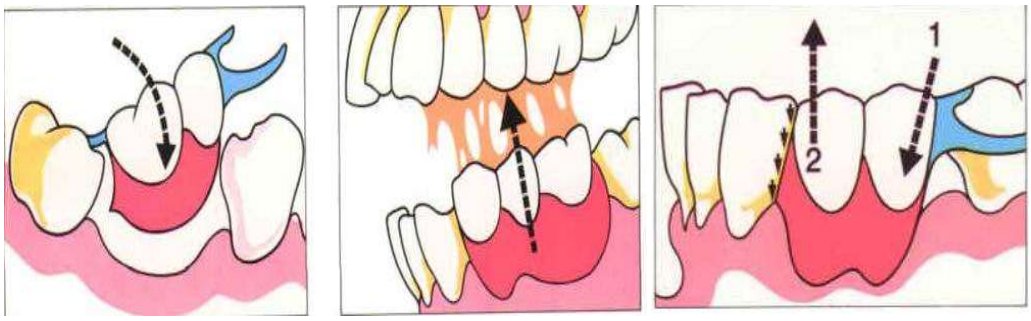


Retentive clasp arms should be bilaterally apposed. It means if on one side the retentive arm is on buccal side and reciprocating on lingual side so the other side of arch same combination should be followed. The retentive arms should also at the same height on both sides. It will keep the bath of insertion same. If the retentive arms are given one side on buccl surface and other side on lingual surface than the RPD will moves towards the buccal side due to single direction of displacement.

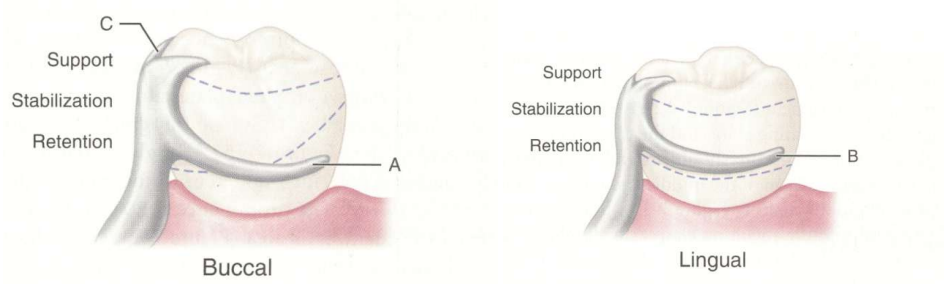


Flexible in Class I cases. In class 1 cases there is rotational and horizontal forces transferring on the terminal abutments as distal extension bases move. To prevent these forces on teeth, give flexible clasps, or stress breakers.

Path of escapement of retentive terminal should not parallel to the path of removal of prosthesis. During chewing the sticky foods try to displace the denture in the vertical upward or downward directions. If the clasps have same vertical path of removal than the RPD will displace with sticky food. So, try to give an angle to the path of removal.



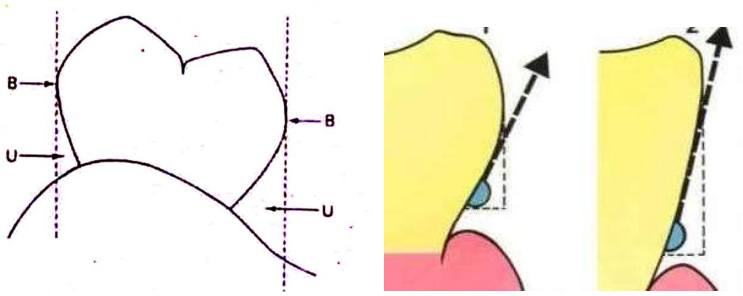
Retentive arm terminal end should be placed in the undercut in the gingival 3rd.It should be flexible.
Reciprocal arm should be placed at the junction of middle and gingival 3rd.It should be rigid



RETENTION OF CLASP

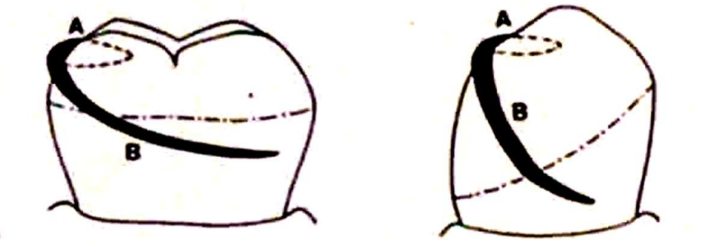
The retention in a clasp depends upon following factors.
Depth of undercut (angle of cervical convergence)
Placement of clasp in undercut (length of retentive arm)
Flexibility of retentive arm

DEPTH OF UNDERCUT (ANGLE OF CERVICAL CONVERGENCE)
It is the depth of undercut on the abutment tooth. On the same tooth different depth of undercuts can be found. As the tooth convergence from maximum bulge area towards the cervical margin we can found different depth of undercuts on different levels. This gradual convergence of crown is called angle of cervical convergence. As the retentive arm placed in undercuts its retention increases as the depth increases. It should be measured with the undercut measuring gauges. Three depth gauges available are 0.25mm, 0.5mm0.75mm**.**
How much undercuts should be engaged is also depend on the tooth and clasp material and shape.



PLACEMENT OF CLASP IN UNDERCUT

It is the length of the retentive arm tip which engages the undercut. If a long arm is placed in undercut than more retention will achieved. How long the arm can be placed in undercut is depends how mush retention is required, the tooth and flexibility of retentive arm.



FLEXIBILITY OF RETENTIVE ARM

It depends on

Length of retentive arm

Diameter of retentive arm

Shape (cross section) of retentive arm

Material of clasp

LENGTH: Longer the clasp arm more flexible it would be and shorter the clasp arm more rigid it would be

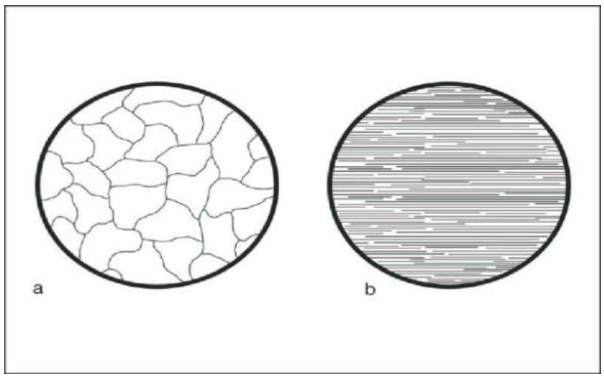
DIAMETER; greater the diameter the clasp arm will be rigid and lesser the diameter the clasp arm will be flexible

SHAPE (cross section) round form is flexible and half round form is less flexible. In cast partial denture the clasp has half round form so they are rigid and must be given in bounded saddles only never in distal extension bases (Otherwise touring forces would be on the abutments).

MATERIAL OF CLASP. Gold is more flexible than cast cobalt chromium

The type of same material structure also affects the flexibility. The wrought material has long crystal so are more flexible while the cast materials have short crystal so they are less flexible and rigid and brittle.

Cast wire



wrought wire

All factors of clasp should be considering combine. In case of premolars the diameter of tooth is less so the retentive arm will be small and show less flexibility. In this case we have to reduce the rigidity of retentive arm as by engaging small under cut or reducing the diameter of retentive arm or using the more flexible material as gold.
In case of molar the diameter is large so the length of retentive arm is also increasing which increases the flexibility and reduces the retention. To increase the retention, we engage the deep undercut. The thickness can also be increased which reduces the flexibility and increases the retention. The material can be use as cobalt chromium which is less flexible.

CIRCUMFERENTIAL CLASP

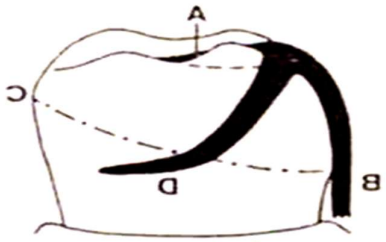
Disadvantages of circumferential clasp
More tooth surface covered (because of its occlusal origin)
It can increase the width of the occlusal surface which results in increase occlusal loads to the tooth
More metal is shown as compare to bar clasp so it is esthetically poor

TYPES OF CIRCUMFERENTIAL CLASP

Conventional Circumferential clasp
Back Action clasp
Reverse Back Action clasp (ring clasp)
Single body Mesiodistal clasp
Split Body Mesiodistal clasp
Embrasure clasp
Split Circumferential clasp

CONVENTIONAL CIRCUMFERENTIAL CLASP

When the undercut is found on the buccal on lingual side away from the edentulous area than conventional circumferential clasp is indicated. It has a body, a rest and one retentive arm and one reciprocating arm originating from occlusal direction.

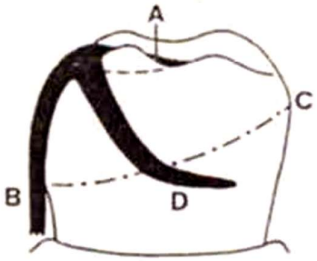


RING CLAPS

It has two types

a. BACK ACTION CLASP

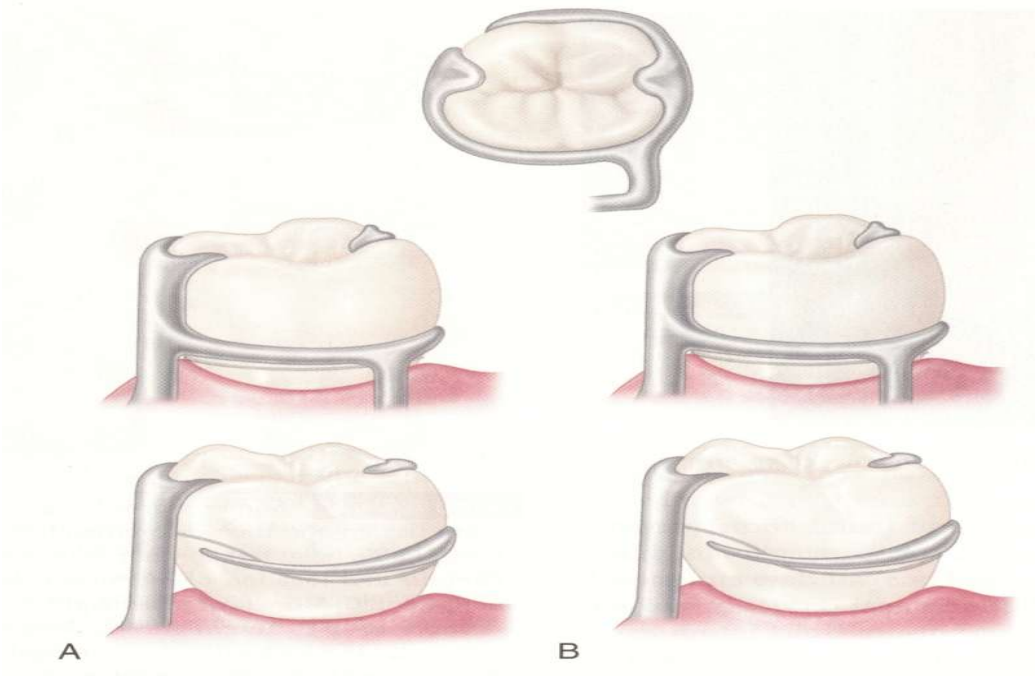
When the undercut is available on the buccal side adjacent to the edentulous area the undercut is too close to the origin of clasp so it cannot engage the undercut. Then back action clasp is indicated. This clasp encircles almost all the tooth from its point of origin.



b. REVERSE BACK ACTION CLASP

When the undercut is available on the lingual side adjacent to the edentulous area the undercut is too close to the origin of clasp so it cannot engage the undercut.
The ring claps should not be used as unsupported ring as it will open and close freely. It should always have a supporting strut. Strut is a minor connector. The part of the clasp anterior to

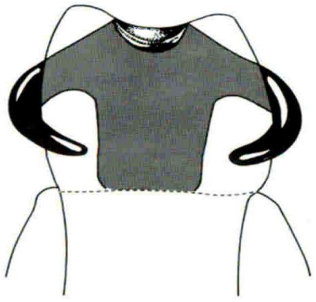
the strut is the retentive arm. The area between the rigid portion of clasp and strut is the reciprocal arm.



BACK ACTION Buccal **REVERSE BACK ACTION** Lingual

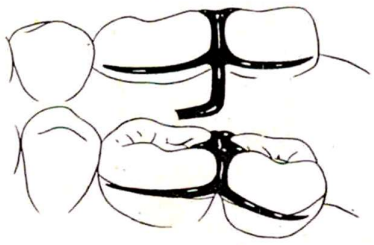
SINGLE BODY MESIODISTAL CLASP

When two undercut areas are available on the same surface as on canines. The body originates from the lingual side and two retentive arms originate one from mesial side and other from lingual side both clasps terminal ends in the undercut will give retention.



EMBRASURE CLASP

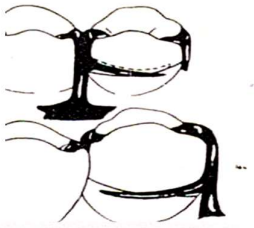
This type of clasp is used where no edentulous space exists as on other side of arch to get retention. It has two retentive arm two reciprocating arms one for each tooth. It originates between the two adjacent teeth and engages undercuts on both teeth. It always has double occlusal rest otherwise wedging of forces will occur.



CLASP

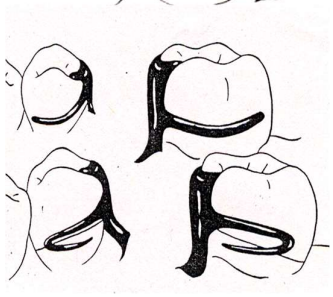
TYPE OF CLASP	Survey line	Undercut area	Indications	Discerption
CONVENTIONAL CIRCUMFERENTIAL	Normal in the middle third of the abutment tooth	Distobuccal or distolingual of the edentulous area on the abutment tooth	In all Kennady classes	One retentive arm and one reciprocating arm
BACK ACTION	Normal in the middle third of the abutment tooth	Mesiobuccal of the edentulous area on the abutment tooth	In all Kennady classes	Encircling the tooth and engage the mesiobuccal undercut
REVERSE BACK ACTION	Normal in the middle third of the abutment tooth	Mesiolingual of the edentulous area on the abutment tooth	In all Kennady classes	Encircling the tooth and engage the distobuccal undercut
SINGLE BODY MESIODISTAL	Undercuts found long axis of the tooth having depressed area on both sides	Mesiobuccal and distobuccal sides of tooth	On Canines with or without adjacent to edentulous area	Both arms are raised from on single body
SPLIT BODY MESIODISTAL	Undercuts found long axis of the tooth having depressed area on both sides	Mesiobuccal and distobuccal sides of tooth	On P`remolars with or without adjacent to edentulous area	Both arms are raised from two bodies one from mesial other from distal
EMBRASURE CLASP	Normal in the middle third of the abutment tooth	Distobuccal or distolingual of the two adjacent abutment teeth	On reciprocal side of the arch without any modification area	Two clasps raised from one body between the two adjacent teeth and encircle them on opposing side of edentulous arch
SPLIT CIRCUMFERENTIAL CLASP	Normal in the middle third of the abutment tooth	Distobuccal or distolingual of the edentulous area on the abutment tooth	Single standing abutment having edentulous areas on both sides	One arm raised from mesial side and other from distal side, any one can be retentive and reciprocation
T-SHAPE BAR CLASP	Very high survey line near occlusal surface	Very near the occlusal surface	On all abutments with atypical survey lines	Bar of T engages the undercut
U-SHAPE BAR CLASP	When there is a dip in the survey line	Both side of the dip		Both arms of U engage the undercuts
L-SHAPE	Very low survey line near cervical boarder	Near the free gingival margin		L bar engages the undercut
C-SHAPE	Diagonal survey line	Diagonally towards the edentulous area		C shape increases the length of retentive arm of the clasp
BALL AND SOCKET	No survey line	No undercut available		A dip in tooth and a ball shape retentive arm

SPLIT CIRCUMFERENTIAL OR HALF AND HALF CLASP



This type of clasp has one arm arising from distal aspect and second arm from mesial aspect. This is given on a long-standing tooth having edentulous areas on both sides of tooth. It has 2 separate bodies or minor connector. One retentive arm originate from mesial side and other from distal side, engaging undercuts on both lingual and buccal sides of tooth.

HAIR PIN CLASP



When the undercut is present directly below the origin of clasp. Just to increase the length of retentive arm of clasp.

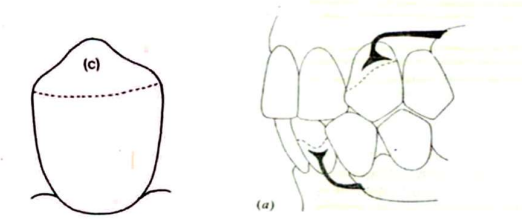
BAR CLASP OR GINGIVALLY APPROACHING CLASP

They approach the undercut from the gingival direction. They display less metal so have good esthetics. They are specially indicated in free end saddles cases as they show more flexibility and transfer less stresses on the abutment teeth. They are indicated where the circumferential clasps cannot be given due to atypical survey lines.

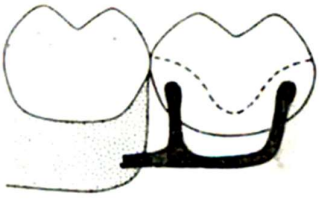
TYPES OF BAR CLASP

The types are according to their shape of terminal end.

- T- Shape
- U- Shape
- L-Shape
- C- Shape
- Ball & Socket

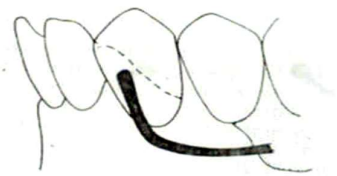


T SHAPED



Its terminal end has a shape of T. It is indicated where no room exist to approach undercut area as in very high survey line near occlusal surface of abutment tooth as no place can be found for rigid part of clasp.

U- Shape

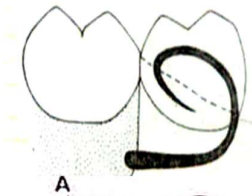


It is indicated where a dip is found in the survey line. So, the rigid part of the retentive arm cannot go in undercut than in supra bulge area and again in undercut.

L-Shape

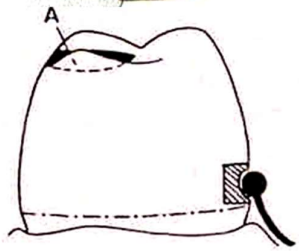
It is indicated where a small undercut is available but very near to gingival margin.

C- Shape



It is indicated where there is a need to increase length of clasp for flexibility to engage the undercut area.

Ball & Socket



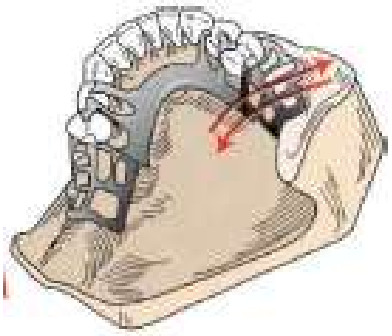
In is indicated where no undercut exists on abutment tooth. There a dip will be created on the tooth surface and the tip of claps should have a rounded ball shape.

INDIRECT RETAINERS

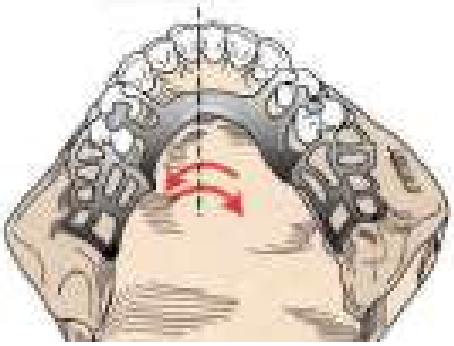
That part of the partial denture, which provide resistance against rotational movements about a fulcrum axis.

MOVEMENTS IN RPD

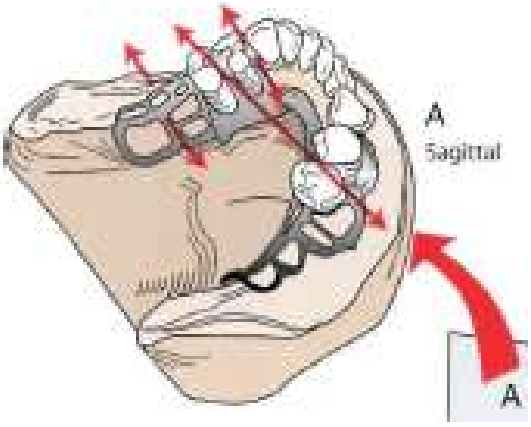
Rotation about a longitudinal axis as distal extension base moves in a rotary direction about the residual ridge.
Resisted by rigidity of major and minor connectors



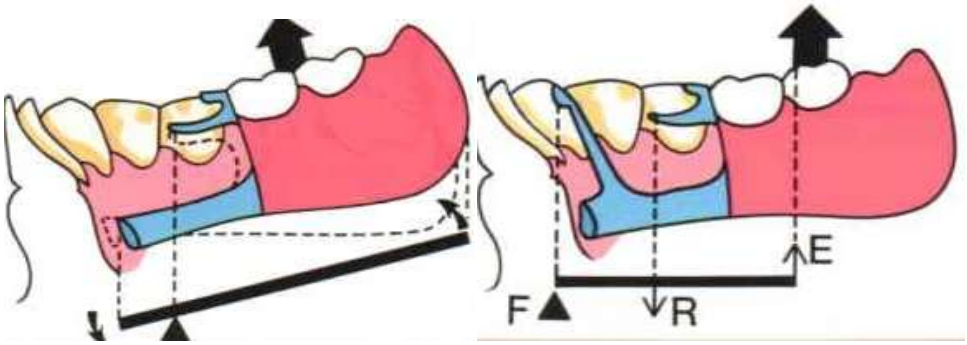
Rotation about an imaginary vertical axis located near the center of the dental arch.
This rotation is resisted by stabilizing components as reciprocating arms minor connectors in contact with vertical tooth surfaces.



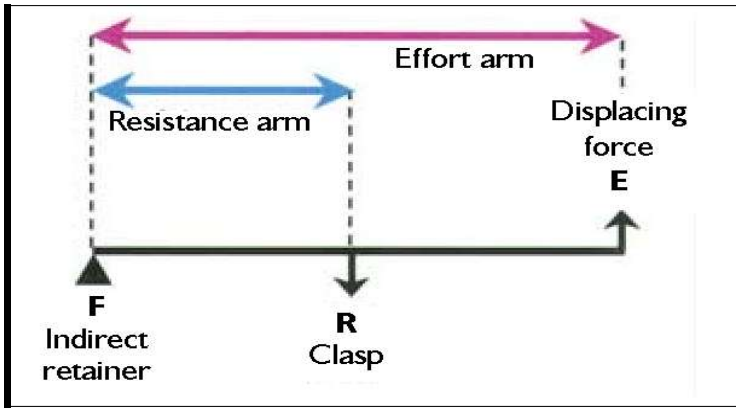
Rotational movement about an axes or Fulcrum line.
This rotation is resisted by the help of indirect retainers.



Fulcrum line is the line joining the two principal rests on both side of arch. This line is exists in Kennedy's class I and II dentures. When patient chew food the food sticks with the dentures and lift up the dentures from basal seat. The rest on abutments acts as a fulcrum and the anterior part of the denture sink into the soft tissues causing trauma.
This downward movement of the denture can be prevented if we can give a rest on anterior teeth as shown in Fig. below



This is the principle of indirect retention.
This type of movement is called lever action. The denture in Kennedy's class I and II acts like a class I lever. The lever has an effort arm between the force and fulcrum and other is resistance arm i.e. between the fulcrum and load to left. If we increase the effort arm the load can easy be lifted. If we increase the resistance arm then heavy force is required to left the load i.e. lever become less effective.
In RPD of class I and II the rest on both side of arch is form fulcrum line. The indirect retainer acts like a load to be lifted. The resistance arm is the distance between the indirect retainer and fulcrum line. The free end saddle is the effort arm, it is from rest to end of denture, and sticky food is the force to lift up the denture.
In RPD our objective is to make this lever ineffective. It can be achieved
1- By increasing the resistance arm i.e. the distance between the fulcrum and indirect retainer.
2- By decreasing the effort arm i.e. distance between the fulcrum and distal end of denture.



FACTORS AFFECTING THE INDIRECT RETENTION

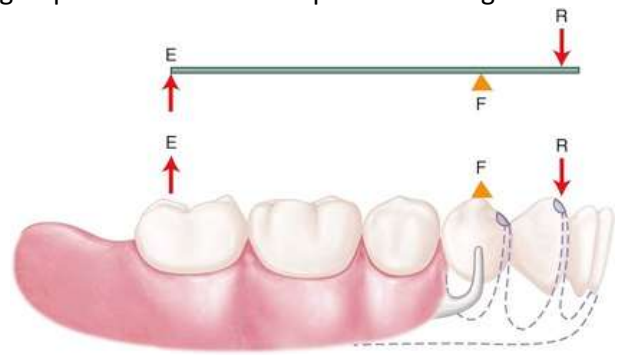
LENGTH OF DISTAL EXTENSION BASE

This is effort arm so it should be as small as possible. It is the distance between the rest and end of free end saddle so try to keep it small.

LOCATION OF FULCRUM LINE

DISTANCE BETWEEN FULCRUM LINE AND INDIRECT RETAINER

This should be as long as possible or at least equal to the length of the distal extension base.



RIGIDITY OF INDIRECT RETAINER

Only rigid retainers can provide effective retention

EFFECTIVENESS OF SUPPORTING TOOTH SURFACE

The tooth surface should be prepared for indirect retainers.

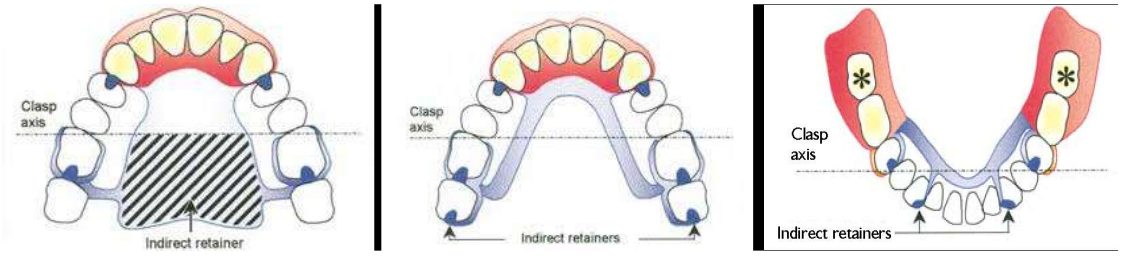
EFFECTIVENESS OF THE DIRECT RETAINER

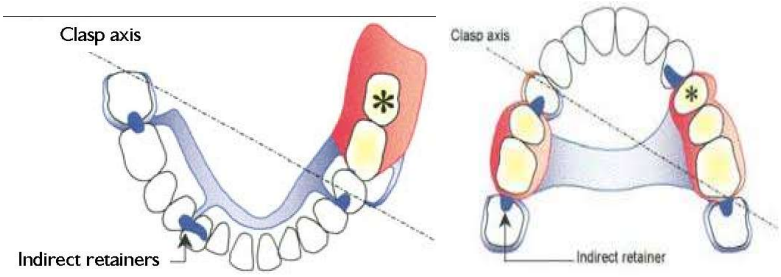
The indirect retainer only effective if the direct retainers are at their planed position. If the rest and the direct retainer fail to retain the clasp assembly then there will be total displacement of the denture and no denture rotation. When denture is totally displaced indirect retainer is of no use so clasps should hold the denture to make it rotate and now this rotation will be stopped by indirect retainer.

INDIRECT RETAINERS

There no special farm of RPD part which called indirect retainer. The other parts can be act as indirect retainers. They are

Auxiliary occlusal rest
Canine extension
Canine rest
Continuous bar, lingual plates
Modification area
Rugae support





Different types of indirect Retainers

DENTURE BASE OR SADDLES

That part of RPD which carries the artificial teeth and transfers the masticatory load to tissues and abutment tooth is called denture base.

FUNCTIONS

It carries the artificial teeth
It transfers the occlusal load to the teeth and tissues
It provides Esthetics
It replaces the lost tissues other than teeth
It stimulates the tissues

TYPES

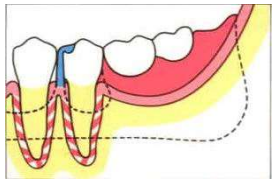
TOOTH SUPPORTED

It has tooth on both sides so the load is transferred on the abutment teeth. This is indicated in Kennedy's class III.

TISSUES SUPPORTED

It is completely resting on soft tissues and transfers the load on soft tissues. This is indicated in Every Dentures and spoon denture and where the abutment teeth are week and cannot take the occlusal load.

TOOTH AND TISSUES SUPPORTED



It has abutment teeth on one side and free end saddle on other side. It has to transfer the load on both teeth and soft tissues. It is indicated in Kennedy's Class I, II and IV cases.

GUM FITTED

These types of bases have no flanges. They are indicated in anterior regions.

INDICATIONS

This is indicated in small edentulous area, in anterior region, where color matching of flange and tissues is difficult. In cases where labial undercuts exist and flanges can cause trauma during insertion and removal or denture cannot be inserted due to severe undercut.

In protruded maxilla cases where addition of anterior flange compromises the esthetics.

METALLIC DENTURE BASES
They are made of cobalt chromium. They have following properties.

THERMAL CONDUCTIVITY
They can transfer the heat to the soft tissues which increase and decrease the blood flow in tissues and keep the tissues healthy. This property is not present in acrylic bases

THICKNESS
They are strong in thin sections so reduce the denture thickness and increase the tongue space. The acrylic bases need more thickness to be strong.

ACCURACY OF FIT
The metal casting shows fewer changes during processing than acrylic bases. So, the metallic bases are more accurately fit.

WEIGHT
The metals are heavier than acrylic. The acrylic bases are lighter in weight.

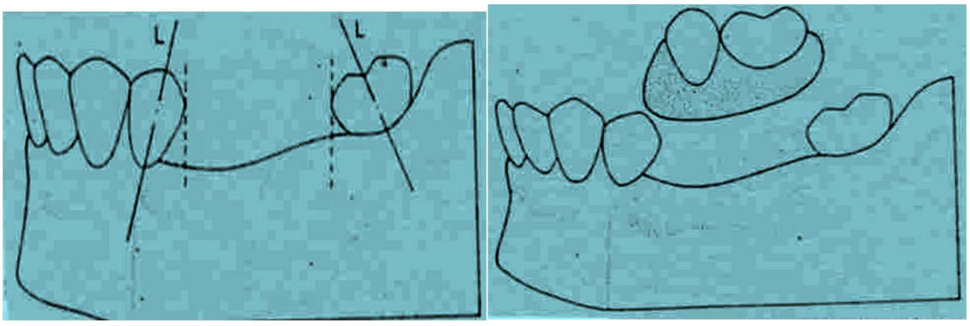
ESTHETICS
The metals cannot carve and have blackish color so they cannot be used in esthetics regions. The acrylics are esthetically good and can be used with metal bases as all flanges should be made of acrylic.

REBASING & RELINING
The metal bases cannot be relined and rebase. The acrylic bases are better in this property.

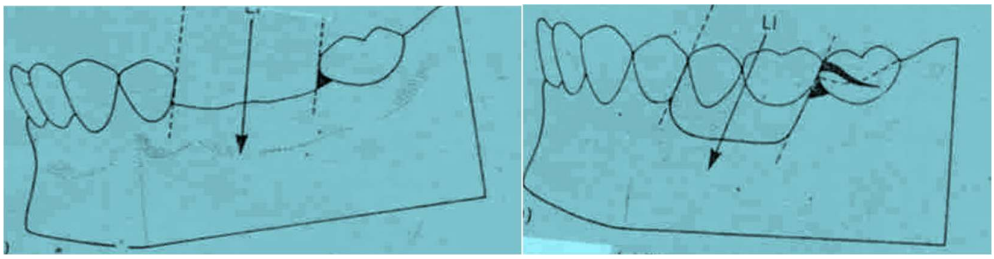
COST
The metals are more costly than acrylic.

SURVEYING THE CAST

The surveying the cast helps to design the path of insertion and removal of the denture, block out of unnecessary undercut and create useful undercuts. It is also helpful in the selection of clasp its location and material and to determine the further mouth preparations.



Denture made without surveying the cast may not be inserted



Denture made after surveying can restore more tissue loss

DENTAL SURVEYOR

It is an instrument used to or assists in contour analysis of hard and soft tissue of dental arch on a cast.

PARTS OF SURVEYOR

Platform on which cast move
Vertical arm supports the supra structure
Horizontal arm holds the surveying tools
Table for cast holding
Tools
- Analyzing rod
- Carbon rod
- Measuring gauges

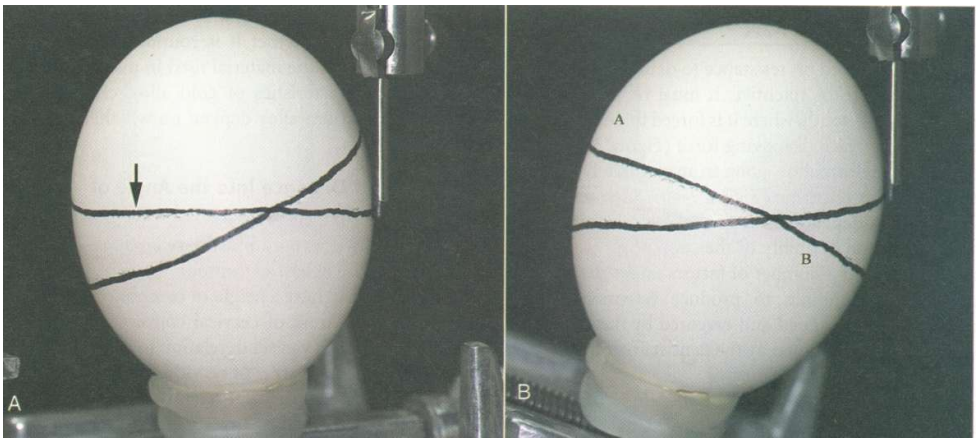
Dental Surveyor Parts
A - Surveying Platform
B - Vertical Upright Column
C - Cross Arm with Spindle Housing
D - Vertical Spindle with Tool Holder
E - Screw to Lock the Spindle
F - Tool Adaptor Holder
G - Surveying Tool Holder
H - Surveying Table
J - Model Clamp
K - Model Table Lock Nut
L - Model Rotating Ball & Socket
M - Ball Rotating Ring
N - Tool Rack
O - Storage Compartment
P - Model Clamp Lock Nut

OBJECTIVES OF SURVEYING

To determine path of insertion
To design retentive elements
To locate interferences
To maintain and improve esthetics

PRINCIPLE OF SURVEYING

If we place an egg on the surveyor and mark the maximum bulge area on it in vertical position. The line on the maximum bulge area is called survey line the part of egg below the line is infra bulge area or undercut area and part above the survey line is called supra bulge area. Now give a tilt to the survey table on right direction and mark the survey line. The changed direction of survey line also changed the supra and infra bulge areas. The areas which were in supra bulge became infra bulge and infra bulge areas become supra bulge by tilting of cast. It means that the presence of under cuts depends upon the tilt of cast. So we can increase or decrease, create or eliminates the under cuts by tilting the cast on surveyor for our RPD design.



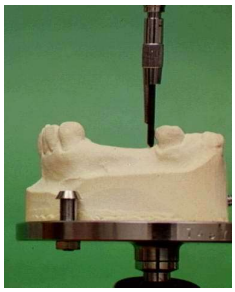
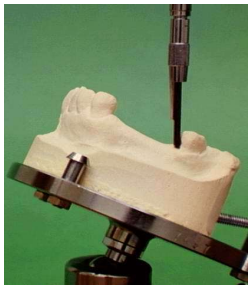
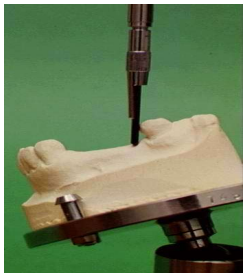
Position the study cast on the surveying table with the occlusal plane horizontal. First use the analyzing rod to check the undercuts all around the cast. Then replace the carbon marker and identify the undercuts might be used or need to be block out.
Having surveyed the cast with the occlusal plane horizontal and consider whether the undercuts revealed are suitable in position and depth for placement of different parts.

TO DETERMINE THE PATH OF INSERTION

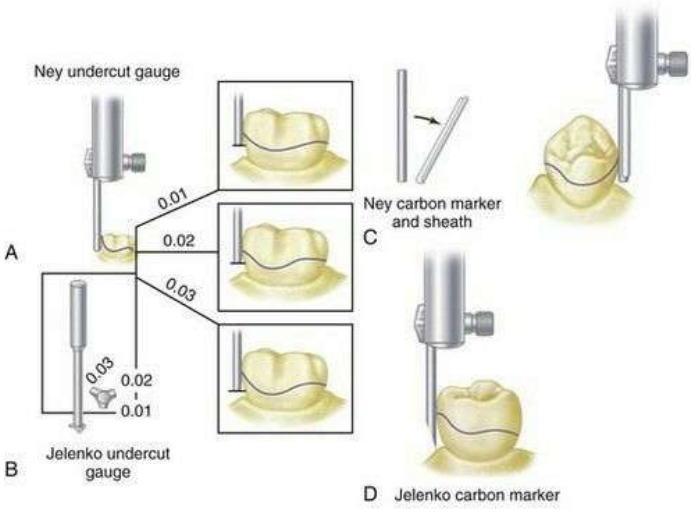
The path of insertion can be made by designing the guide planes.

Determine the relative parallelism of proximal surfaces of all of the potential abutment teeth. Alter the cast position anterior posterior until their proximal surfaces are in a parallel relation to one another, or near enough that they can be made parallel by re contouring. This will determine the anterior posterior tilt of the cast, and path of insertion and removal of RPD, in relation to the vertical arm of the surveyor.

In making a choice between having contact with a proximal surface at the cervical area only or contact at the marginal ridge only, the latter is preferred because a plane may then be established by re contouring. Because when only gingival contact exists, a restoration is the only means of establishing a guiding plane. In other instance the guide plains can be design by re contouring the proximal surfaces.

DESIGN RETENTIVE ELEMENTS



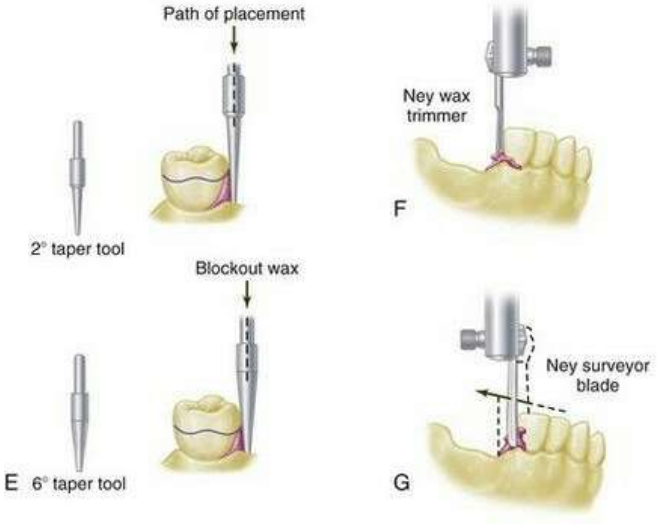
The principle of tilting the cast for retention is that the new path of insertion and removal enable the retentive arm of clasp to fit closely against an area of the tooth surface that is undercut relative to the path of insertion. To equally distribute the undercuts so that the survey line is at the same level all-around as close to cervical margin as possible.

By contacting buccal and lingual surfaces of abutment teeth with the surveyor blade, the depth of undercuts existing below their height of convexity may be determined.

Alter the cast position by tilting it laterally until similar retentive areas exist on the principal abutment teeth.

Now use the depth gauges to measure the different depth levels on the same abutment tooth and mark them with pencils of different colors.

In tilting the cast laterally to establish uniformity of retention, i.e., the location and depth of the undercuts will be the same on both side of arch.



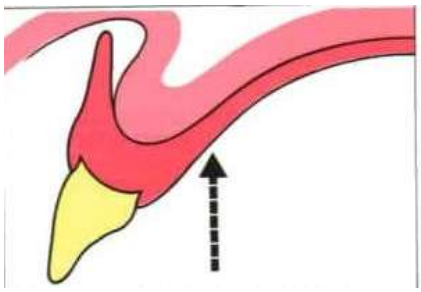
LOCATE INTERFERENCES

In horizontal plane if it is noticed that an undercut on the ridge cause obstruction to denture flange. Tilting the cast posterior until the analyzing rod become parallel to the labial surface of the ridge enables a path of insertion to be selected that will permit the flange to fit the ridge accurately.

A lingual undercut in the premolar area may make it impossible to place a lingual bar major connector. An anterior tilt to the cast indicates a path of insertion that reduces the interference.

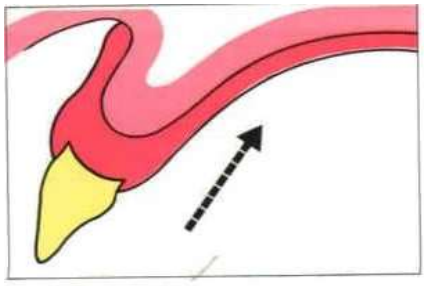
If a mandibular cast is to be surveyed, check the lingual surfaces that will be crossed by a lingual bar major connector. Bony prominences and lingual inclined premolar teeth are the

most common causes of interference to a lingual bar connector.



If the interference is bilateral than surgery or re contouring of lingual tooth surfaces or both are recommended. If it is unilateral, the lateral tilt may avoid an area of tooth or tissue interference.

In a like manner, bony undercuts that will cause interference to the seating of denture bases must be evaluated and the decision must be made to remove them surgically or to change the path of insertion. The latter may be done by shortening buccal and labial flanges extension.



Other areas of possible interference to be evaluated are those surfaces of abutment teeth that will support or be crossed by minor connectors and clasp arms. The interference to vertical minor connectors may be blocked out.

MAINTAIN AND IMPROVE ESTHETICS

If an anterior edentulous area undercuts are frequently found on the mesial side of the abutment teeth when surveyed with the occlusal plane horizontal. If the denture is constructed utilizing this vertical path of insertion there will be a gap below the contact point of the saddle and abutment teeth. The gap can be avoided by giving the posterior tilt to the cast. The new path of insertion permits the saddles to contact the entire mesial surface of the abutment tooth, resulting in improved appearance.

The deep under cut in anterior maxilla can also be utilized by giving an anterior posterior tilt to path of insertion. It eliminates the undercut and also improves esthetics.

MEANS TO GET RID OF UNDESIRABLE UNDERCUTS

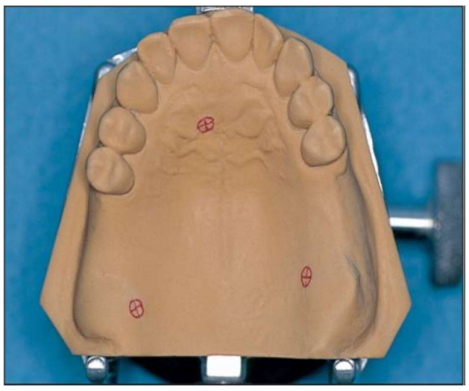
1-Tilting of cast
2-Undercut block out
3-Axial re contouring
4-Restorations by
Restorative materials
Inlay
Only
Crowing

MEANS TO CREATE DESIRABLE UNDERCUTS

1-Tilting of cast
2-Axial re contouring
3-Restorations by
Restorative Materials
Inlay
Only
Crowing

TRIPODING

Is a method of indexing the cast while it is on the surveyor so that it can be removed and returned to its original position whenever it is desired.

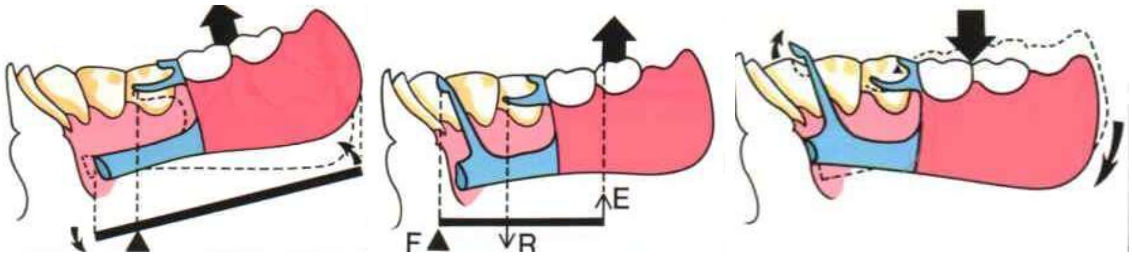


First method is to place three widely divergent dots on the tissue surface of the cast with the tip of a carbon marker, having the vertical arm of the surveyor in a locked position. Preferably these dots should not be placed on areas of the cast not involved in the framework design. The dots should be encircled with a colored pencil for easy identification. On returning the cast to the surveyor, it may be tilted until the tip of the surveyor blade or diagnostic stylus again contacts the three dots in the same plane.

Second method is to scratch lines on two anterior sides and one on dorsal aspect of the base of the cast with an instrument held against the surveyor blade. The original cast position can be reestablished by tilting the cast until all three lines become again parallel to the surveyor blade. The scratch lines will also be reproduced in duplication, thereby permitting any duplicate cast to be related to the surveyor in the same manner.

STRESS BREAKING (Composite Support, Dual support Problem)
PROBLEMS OF KENNEDY'S CLASS I & II

In Kennedy's class I and II cases i.e., free end saddles, due to absence of posterior abutment the RPDs has two additional movements as compare to class III cases. The first movement is along the fulcrum line and away from the supporting tissues. This movement can be prevented with the help of indirect retainers. The second movement is the movement of RPD towards the supporting soft tissues. As the RPD is supported anterior by teeth and posterior by soft tissues this is called composite support. This movement is due to the difference of compressibility of abutment teeth and soft tissues. During chewing the soft tissues compress more than the teeth move the denture down ward from posterior end and cause harmful effects on abutment teeth (nailing out movement). This movement can be prevented by equalizing the compressibility of soft tissues and abutment teeth.



OBJECTIVES OF TREATMENT IN KENNEDY CLASS I & II

Required Indirect retention
Balance the Composite Support
Distribute load on maximum possible area
Prevent abutments form harmful force

BALANCE THE COMPOSITE SUPPORT

The composite support problem can be solved by
Impressions
Rests
Direct retainers
Split major connectors
Dual casting
Stress breakers

IMPRESSIONS

By the help of impressions, we can reduce the compressibility difference between teeth and soft tissues by recording the impression of soft tissues in functional form and teeth impression in anatomical (resting) form. To achieve this there are different impression techniques available as
Double impression technique
Split Cast Impression Technique
Apple Gatte Impression Technique

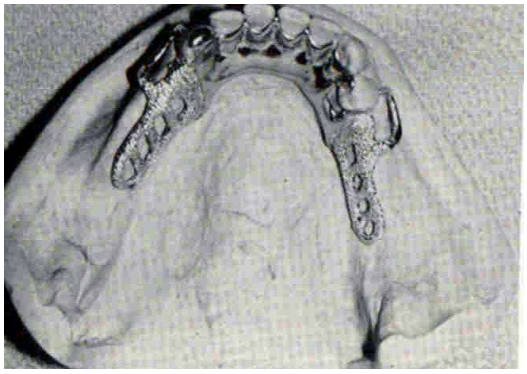
DUAL OR DOUBLE IMPRESSION TECHNIQUE

This is the simplest method to record the impression of teeth and soft tissues in different form in the same impression. In this method the impression of free end sable areas of the arch is recorded in impression compound. The impression compound is a muco compressive impression material it records the functional impression of the tissues. The impression of teeth is now recorded in alginate. The alginate is a muco static impression material and records the anatomical form of teeth. By this, the two types of impression, can be recorded in the same impression tray.

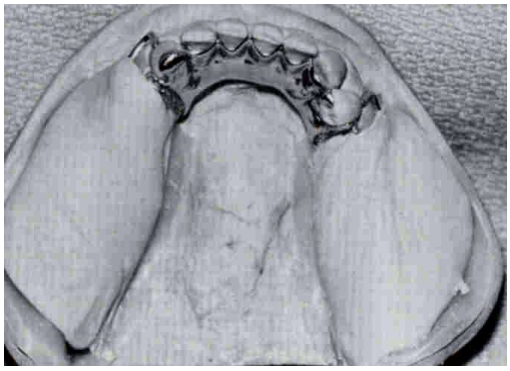
SPLIT CAST IMPRESSION TECHNIQUE
ALTERED CAST IMPRESSION TECHNIQUE

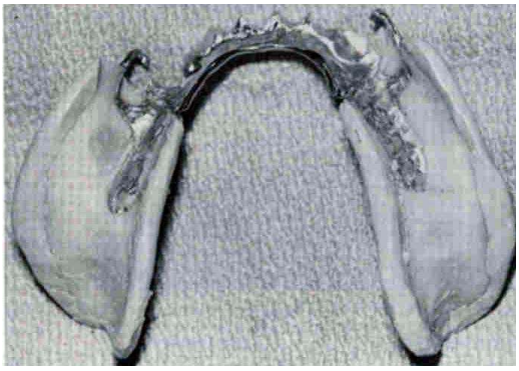
This is the special type of impression technique which can accurately record the impression of free end saddles in functional form and teeth in anatomical form.

Steps of split or altered cast impression technique
Record the impression of cast with double impression technique and cast a frame work for RPD. Now adjust the frame work on the master model.

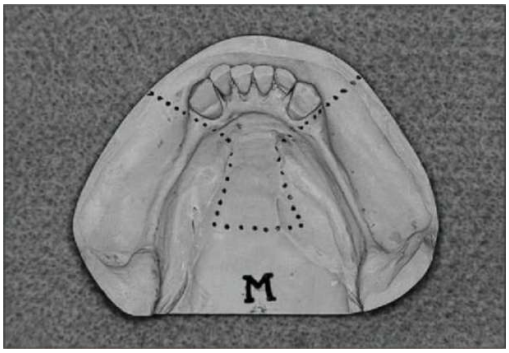


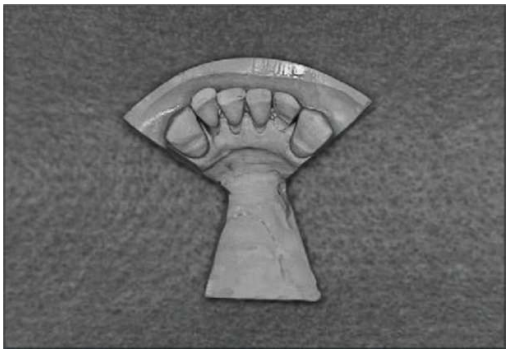
Make special tray only on free end saddles with framework. Remove the special tray



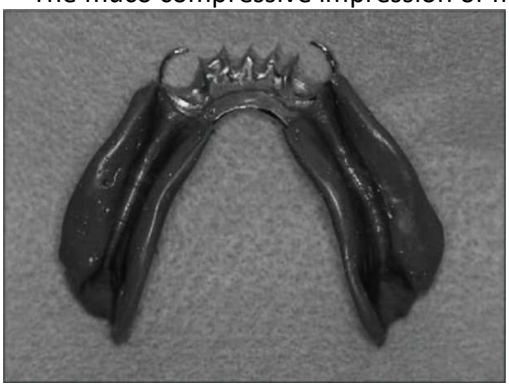
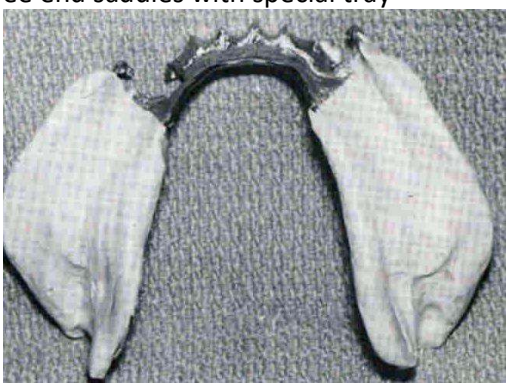


Mark the free end saddles and cut the cast to remove the free end saddles

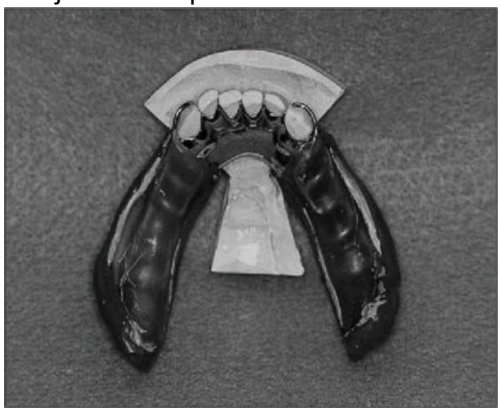
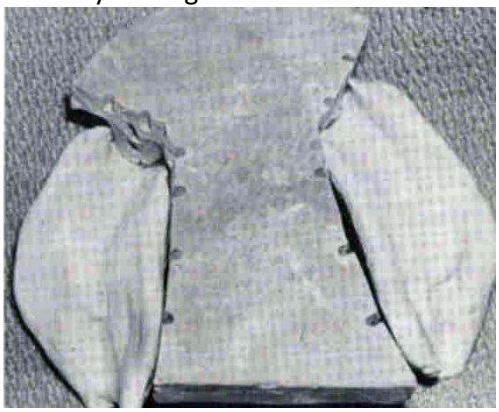




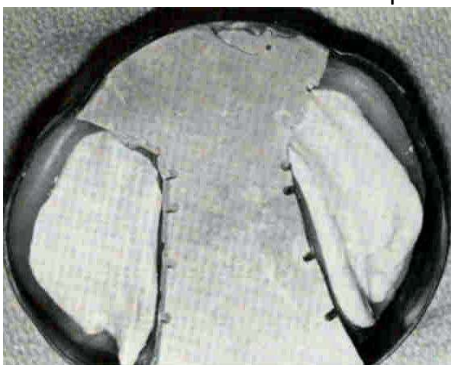
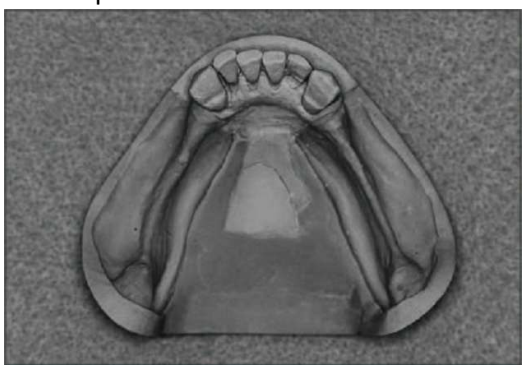
The muco compressive impression of free end saddles with special tray

Adjust this impression on cast of teeth saved by cutting of master cast

Box the impression and pour it

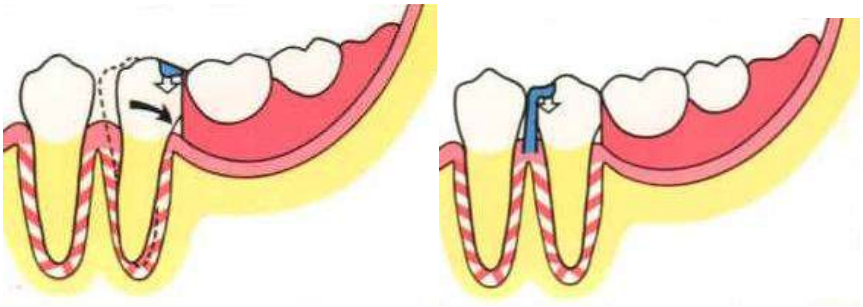



The new Altered cast having anatomical teeth form and functional free end saddles.

When use the impression waxes for secondary impression this is called **Apple Gate impression technique**

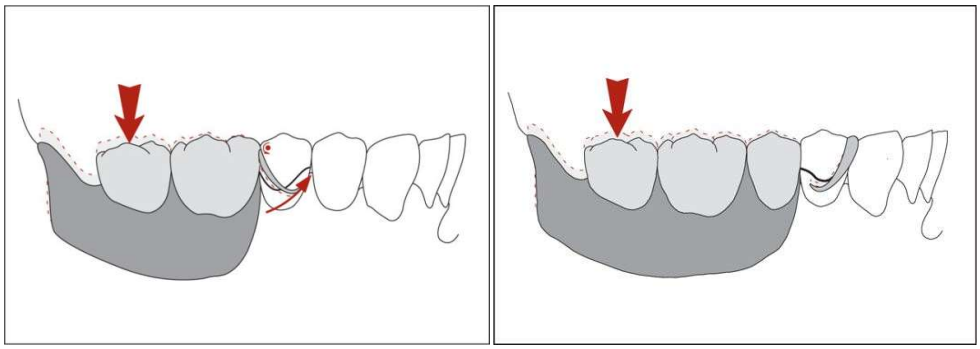
ROLE OF REST

Moving rest away from saddle area can help to utilize the free end saddle area. It also prevents the tilting of abutment teeth towards the saddle area.



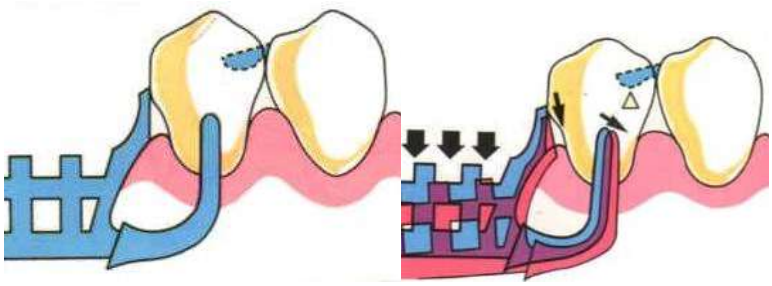
ROLL OF DIRECT RETAINER

The use of conventional circumferential clasp causes the nailing out effect on the abutment tooth when force is applied on the free end saddle. This can be prevented by using flexible retainers. This can be done by engaging the buccal under cut near the edentulous area by using back action clasp which is more flexible. The wrought iron retentive arm can be utilized which is most flexible.



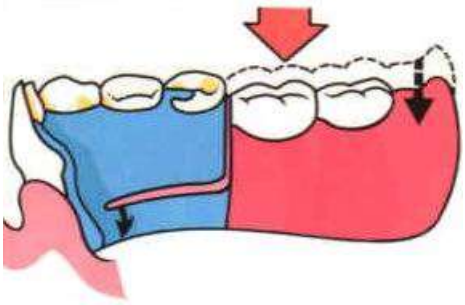
RPI SYSTEM

This is the combination of I-bar retainer, mesial Rest, and distal Proximal plate. When the force is applied on the free end saddle the I- bar disengages the abutment tooth, the mesial rest prevent the distal tipping of abutment and proximal plate keeps the denture at is place and transfer the load on teeth and ridges as planned. In this way the IRP System prevents the abutments from harmful forces and transferred the forces on ridges and abutment teeth as desired.



SPLIT MAJOR CONNECTOR

By splitting the major connector horizontal from posterior side and keeping intact at the mid line can also split the forces and allow the free end saddles move down ward independently.

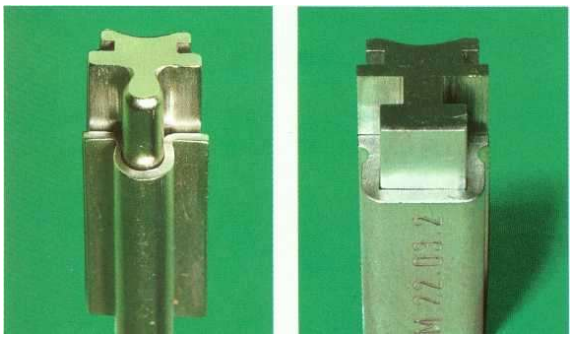


DUAL OR DOUBLE CASTING

The gold is a soft alloy and show flexibility. If we cast tooth supported part of denture in cobalt chromium alloy and tissue supported part in gold alloy so when force is applied on free end saddle that part move down ward independently.

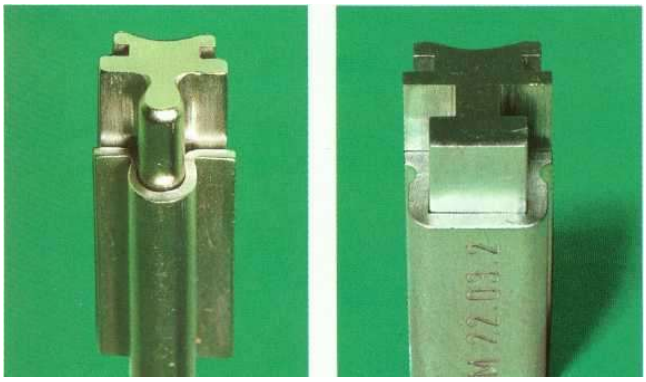
STRESS BREAKERS DEVICES

These are pre formed devices which can attach with denture and abutment tooth. These devices can move up and down movements and distribute load independently on teeth and ridges.



PRECISION ATTACHMENTS

These are special type of machine-made devices used as direct retainers.
They are consisting of two parts
Matrix (Male)
Patrix (Female)
The Matrix fixed in denture and Patrix attached with the abutment.



CLASSIFICATION
They can be classifying according to their location of attachment.

EXTRA CORONAL
They are attached with the crown of abutment external to its circumference.

INTRA CORONAL
They are attached to the abutment teeth with in its circumference.

INTRA RADICULAR
They are fixed in the prepared roots of the abutment teeth. They are in shape of Bar and Studs. They are used in over denture abutments.

Extra coronal **Intra coronal** **Intra radicular**

ADVANTAGES

RETENTION
They provide better retention to dentures by the fixing mechanism of devices.
ESTHETICS
They can be given in esthetic zone due to elimination of retentive clasp arm and more esthetic than clasps.
BETTER STRESS DISTRIBUTION
They can transfer stress to the abutment teeth in better way than clasps due to their precise location on abutment teeth and denture.

DISADVANTAGES
Highly skilled workmanship is required for their incorporation in teeth and denture.
They are more costly due to cost of device and extra lab charges.
They are not conservative treatment because more tooth preparations are required to incorporate the device in the crown.

INDICATIONS
Tooth supported RPD
Elimination of clasp arm on anterior teeth for aesthetics.

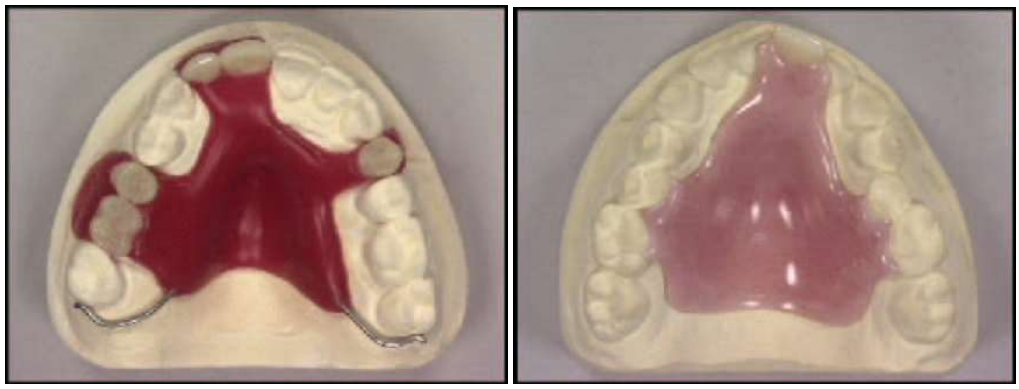
CONTRAINDICATIONS
They are not indicated in Kennedy I&II cases. Here stress Breaker is used.
In Handicap Patients not indicated as they need manual dexterity for insertion and removal

USES
Moveable joints in FPD
To retain RPDs
Over dentures
Implant supported dentures

LIMITATIONS
Short clinical crowns
Large pulps
Lack of skilled laboratory facility
Cost

SOFT TISSUES SUPPORTED DENTURES

The dentures completely supported by soft tissues are
Every denture
Spoon denture

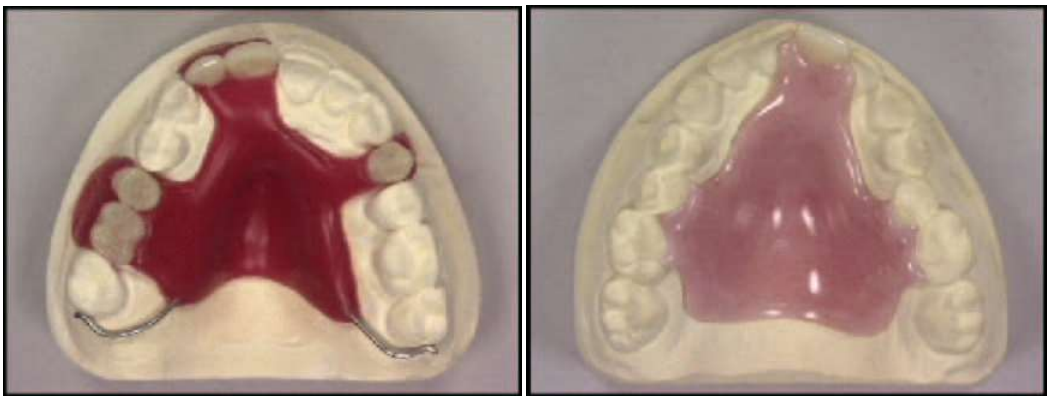


Every denture is Mucosa Born Denture and only for Upper Arch to replace one or more Teeth in Kennedy's class III cases with modification. They have no clasps for retention. The retention is achieved by restoring the contact points with the natural teeth. The spoon denture is given in only missing one or two anterior teeth.

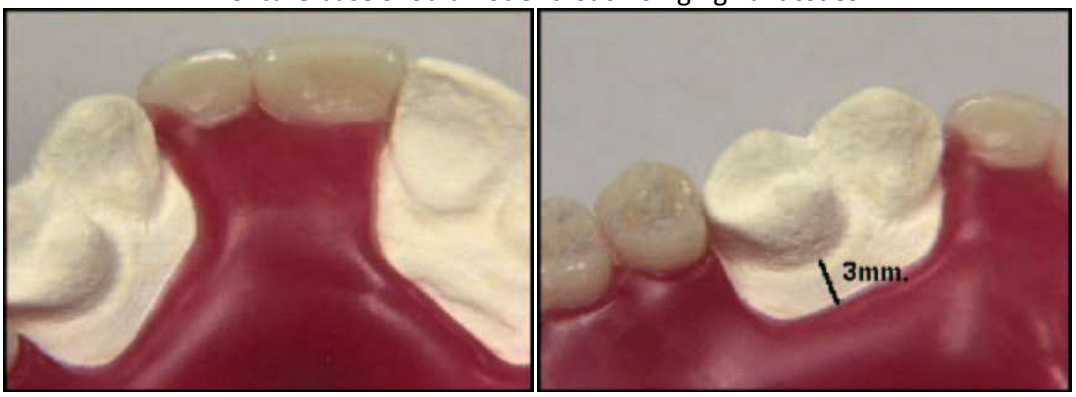
PRINCIPLES

Restoration of contact points for arch integrity

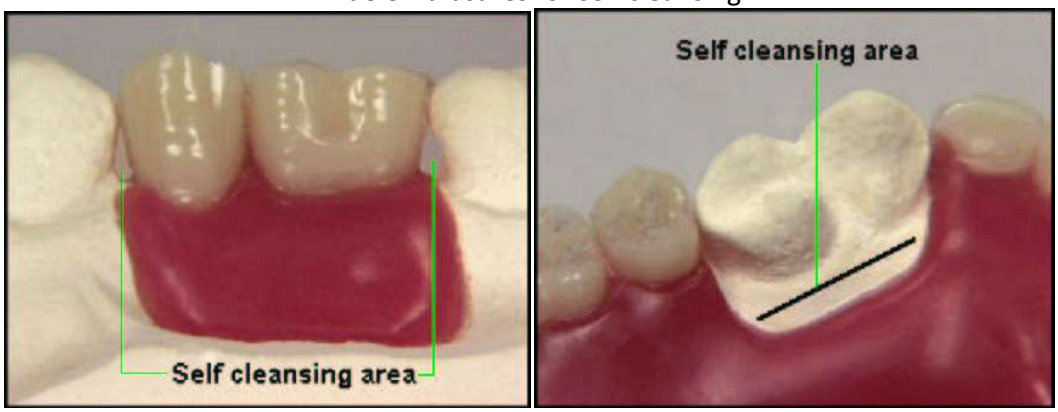
Large base extended distally for retention & support



Denture base should not encroach on gingival tissues

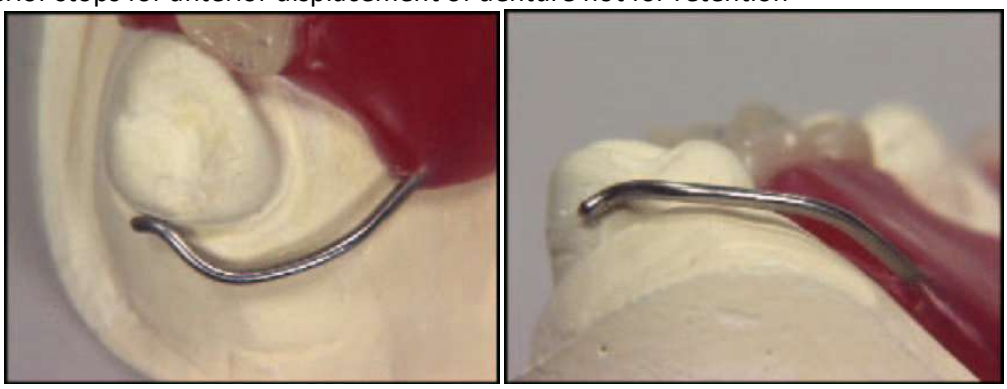


Wide embrasures for self cleansing

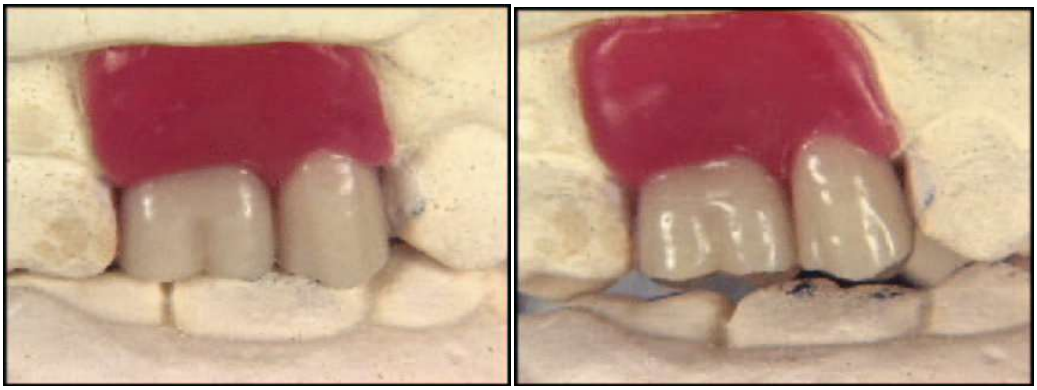


Lateral & posterior stability by flanges

Posterior stops for anterior displacement of denture not for retention



Free occlusion and no lateral contacts



STEPS OF CASTING RPD

This is a brief introduction of casting steps.

Diagnostic cast

A diagnostic dental cast is a cast/model of a person's teeth that a dental professional use as a guide in the application of corrective or restorative dentistry. Such diagnostic casts are often referred to as study models.

Master cast

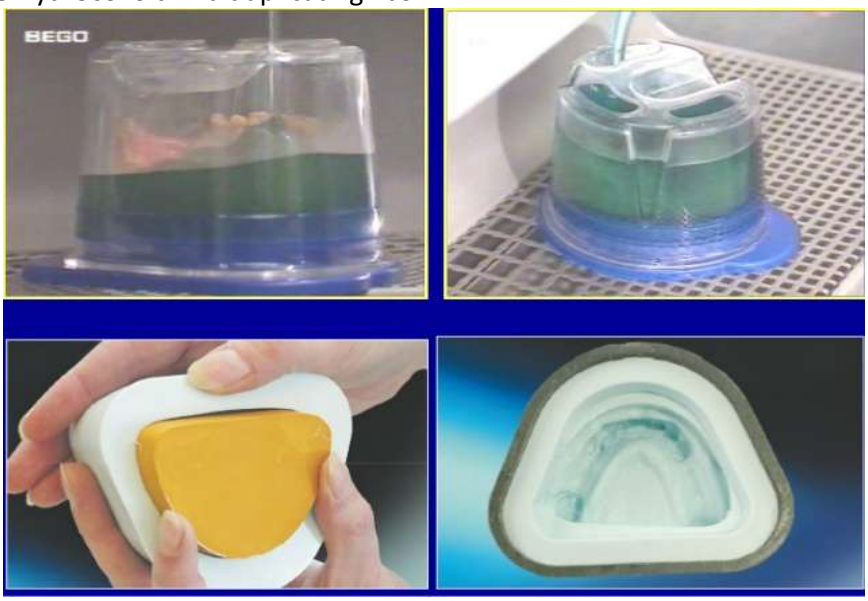
A cast is made from an impression taken after preparing tooth surfaces, residual ridge areas, and/or other parts of the dental arch.

Refectory cast

A cast made of material that withstands the high temperatures of metal casting or soldering without disintegrating by duplicating the master cast.

Model duplication

To make refractory cast used for casting RPD frameworks by duplicating the modified (blocked out and relieved) master cast. The material use for this purpose is called Agar-Agar a reversible Hydrocolloid in a duplicating flask.



Refectory cast

The duplicating mold is poured with investment material which can withstand the high temperatures of metal casting or soldering without disintegrating.

Wax-dip (hardening cast)

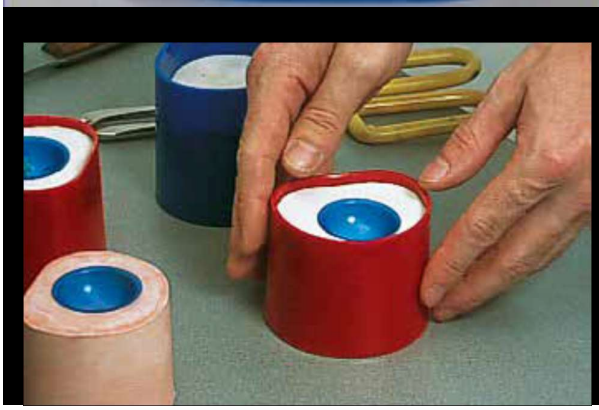
Refectory cast is dipped in a liquid called model hardener which assures a smooth dense cast necessary for waxing procedures

Wax up and Spur attaching

Transfer design from the master cast to the refractory casts. Spur are the wax sticks which attaché to the wax pattern to make channels for metal flow.

Investment Ring/Mold Preparation

Investment materials are used to make a mold into which the liquid metal can be poured during the casting process (as like flasking the denture).



Burn out

The purpose of burn out is to heat the mold so the wax can burn in it and left the space for flow of metal and heat up at a temperature where molten metal can flow easily without solidify, in a preheated furnace.

Metal casting

After burn out the heated mold is placed in the casting machine where the metal is melted and poured into the mold.

REMOVAL OF CASTING FROM THE INVESTMENT

After the casting is complete the mold is allowed to cool and at the approximate time the mold is broken by tapping it with a wooden mallet to break off the outer layer of investment.

Sand blasting

Sand blasting is use to remove the fine partials of investment material stick to the metal frame work.

Spur cutting, Finishing & Polishing

Spur which are attached for metal flow now has to cut down with cutting disc.

DIAGNOSIS AND TREATMENT PLANNING FOR RPD

Objectives of Prosthodontic treatment

1. Elimination of the disease
2. Preservation, restoration, and maintenance of the health of the remining teeth and oral tissues.
3. Selected replacement of lost teeth
4. Restoration of functions

SIX PHASES OF PARTIAL DENTURE TREATMENT

1. Patient education
2. Diagnosis, treatment planning, design, treatment sequence, and mouth preparation
3. Support for distal extension denture bases
4. Establishment and verification of occlusion relation and tooth arrangements
5. Initial placement procedure
6. Periodic recall

PHASE I

Patient education

PHASE II

Diagnosis, treatment planning, design, treatment sequence, and mouth preparation

Oral Examination

Sequence of oral examination

1. Relief of pain and discomfort and caries control by placement of temporary restorations
2. A thorough and complete oral prophylaxis
3. Complete intra oral radiographic survey
4. Impressions for making accurate diagnostic casts to be mounted for occlusal examination
5. Examination of teeth, periodontium and residual ridges
6. Vitality tests of remaining teeth
7. Determination of height of floor of the mouth

Complete intra oral radiographic survey

1. Disease validation
2. Tooth support
3. Bone density
4. Bone index area
5. Alveolar lamina dura
6. Root morphology
7. Third molar

Diagnostic mounted casts

1. Complete occlusal analysis (lingual view)
2. Treatment planning, outlining the abutment preparations
3. Patient education
4. Record keeping

Patient examination for RPD

Factors to be consider for the treatment planning of RPD

1. Location and size of edentulous area
2. Abutment teeth
3. Residual ridges
4. Opposing occlusion

FACTORS OF RPD DESIGN

CLASS	EDENTULOUS AREA	ABUTMENT TEETH	RESIDUAL RIDGES HEIGHT	OPPOSING OCCLUSION
Class I	Small 1-2 missing teeth	Ideal or minimally compromised condition (no pre prosthetic therapy required)	More than 21mm	Ideal or minimal compromised occlusion
Class II	Medium 3 missing teeth	Moderately compromised condition (localized pre prosthetic therapy required, intra coronal restorations required)	16-20 mm	Moderately compromised occlusion (enamelo plasty for premature occlusal contact)
Class III	Large more than 3 teeth	Substantially compromised condition (extensive pre prosthetic therapy required as endo & crowning)	11-15 mm	Substantially compromised occlusion (reestablish occlusion without change in OVD, Class II molar relation)
Class IV	Free end saddles	Severely compromised condition with guarded prognosis (splinting with other tooth required)	less than 10mm	Severely compromised occlusion (reestablish occlusion with change in OVD, Class II Div. 2, Class III molar relation)

Vitality tests of remaining teeth

Determination of height of floor of the mouth

DIAGNOSIS

Indications for FPD

1. Tooth bounded edentulous regions (small)
2. Modification spaces
3. Anterior modification spaces

Indications for RPD

1. Distal extension bases
2. After recent extraction
3. Long span edentulous regions
4. Need of Bilateral stabilization (periodontally compromised teeth)
5. Excessive loss of residual ridge
6. Abutments with guarded prognosis
7. Unusually sound abutment teeth
8. Economic considerations

Principles of RPD design

1. A RPD should restore form and function without injury to remaining oral structure
2. The prosthesis should restore a normal or desirable facial contour and not impending the normal movements of tongue and facial tissues.
3. The prosthesis must not stress the remaining oral tissues beyond their physiological limits.
4. The design of RPD should accommodate future modifications and expected oral tissues changes.

TREATMENT PLANNING

Mouth preparations for RPD

1. Surgical procedures
2. Periodontal procedures
3. Conditioning of abused and irritated soft tissues
4. Abutment tooth preparations

INDICATIONS FOR EXTRACTION

If the tooth cannot be restored to a state of health
If its absence will permit a more serviceable and less complicated RPD design (lingually, buccally, mesial inclined, over erupted teeth,
Unaesthetically located teeth

Periodontal procedures

Conditioning of abused and irritated soft tissues

ABUTMENT TOOTH PREPARATIONS

Type I

Require only minor modifications to their coronal part

Preparation of the proximal surfaces parallel to the path of insertion for proximal plates (guide planes)

Modification of tooth contour to make maximum bulge (survey line) in the middle of the crown for clasp design

Rest seat preparation to direct the occlusal forces along the long axis of the abutment tooth

Type II

Abutment needs restoration other than complete coverage crown

Inlays on proximal surfaces for guiding planes

Onlay on occlusal surface for rest seat preparation due to existing restorations, occlusal morphology (tooth surface loss).

Type III

Abutment needs complete coverage crown

Extensive restorations, tilting, over eruption

Tooth morphology not allowed modifications for rest seat, guide planes or retentive contours

The ideal tooth contours for claps, guide planes and rest seats can be made in full coverage crowns (called surveyed crown)

Type IV

Splinting of the abutment teeth

A tooth considers too weak to use alone as an abutment due to short crown length, excessive taper of a single root, bone loss, unfavorable crown to root ratio con be splinted with other teeth for better support. Thus, two single rooted teeth can serve as a multirooted abutment (two premolar, first premolar and canine, anterior teeth)

STEPS OF RPD DESIGN

1. Determine the support of RPD (rest & denture bases)
2. Connect the tooth and tissue support
3. Retention of RPD
4. Connect the retention unit to support unit
5. Out line and connect the edentulous area to other components

Phase III

Support for distal extension denture bases

Tooth support

Factors effecting support of abutment
Periodontal health and restorability
Crown and root morphology
Crown to root ratio
Bone index area (response to previous stresses)
Location in the arch
Relation to the edentulous area
Opposing dentition

Bone support

Quality of residual ridges (contour & quality, stress response)
Length of residual ridges
Type and accuracy of impression registration
Accuracy of denture base
The design of RPD
Anticipated occlusal load

Principles for support

Stress equalization
Physiological basing
Broad stress distribution

Phase IV

Establishment of occlusion

1. Simultaneous bilateral contact of opposing teeth in centric occlusion
2. Class III the occlusion of tooth supported RPD be arranged similar to opposing natural occlusion
3. When complete denture in one arch opposing RPD bilateral balance occlusion is required
4. In class I bilateral balance occlusion is required
5. In class II unilateral balance occlusion on working side is required
6. In class IV contact of anterior teeth is centric relation is required to prevent the eruption of opposing incisors.
7. No tooth on upward inclines of distal mandible residual ridge and over retromolar pad

Phase V

Initial placement procedure
Base adjustments
Occlusion adjustments

Phase VI

Periodic recall

1. Relining
2. Rebasing
3. Repairs
4. Additions

MAXILLOFACIAL PROSTHODONTICS

It is the branch of Prosthodontics which deals with the restoration of acquired and congenital loss of hard and soft tissues in oral and maxillofacial region.

CONGENITAL DEFECTS OF MAXILLA

The cleft palate and lip are the congenital defects of maxilla. They can be classified

Class I

Soft palate defects

Class II

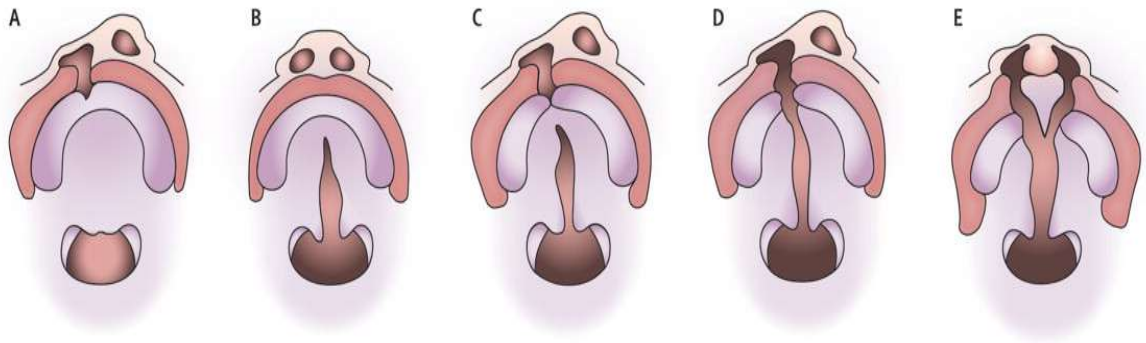
Soft and hard palate defect

Class III

Soft and hard palate defect with unilateral lip defect

Class IV

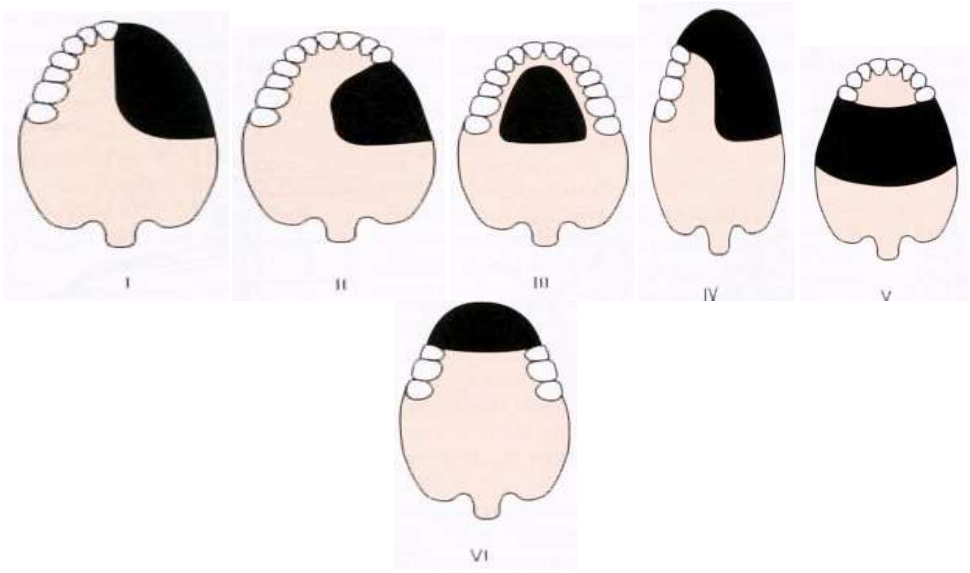
Soft and hard palate defect with bilateral lip defect



ACQUIRED DEFECTS OF MAXILLA

These defects are the result of surgery mostly of tumors. The classification of acquired defects is called Aramany's Classification which is

Class I	Midline resection.
Class II	Unilateral resection
Class III	Central resection
Class IV	Bilateral anteroposterior resection
Class V	Posterior resection
Class VI	Anterior resection



OBTURATERS

The prosthesis which used to restore the maxillary defects is called Obturator. It serves to restore separation of the oral and adjacent cavities following surgical resection of tumors of the nasal and paranasal regions.

There are three types of obturators

1**- PRE-SURGERY OBTURATOR**

It is fabricated before the surgery of patient according to surgeon requirements and inserted immediately after the surgery.

2**- INTERIM OBTURATOR**

The pre surgery obturator can modified according to healing of tissues and relined with tissue conditioners is now called interim obturator.

3**- PERMANENT OBTURATOR**

After the healing of tissues and stabilization of the condition of patient a permanent obturator can be fabricated.

PROSTHESIS FOR SOFT PALATE DEFECTS

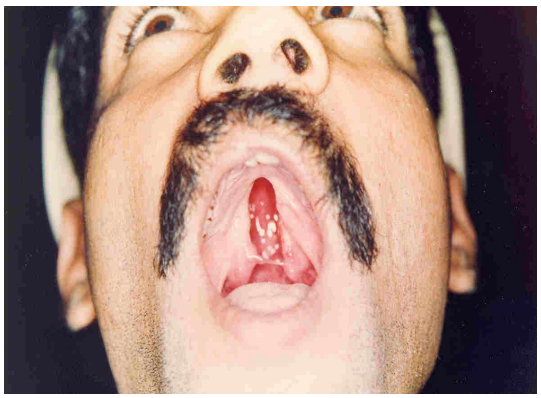
There are two types of prostheses given in patients with palatopharyngeal defects.

SPEECH AID PROSTHESES

It is given in patients with soft palate anatomical defect acquired of congenital. It is functionally shaped to the palatopharyngeal musculature to restore or compensate for areas of the soft palate that are deficient because of surgery or congenital anomaly.

PALATAL LIFT PROSTHESES

This prosthesis is given in patients with soft palate functional defect as motor nerve paralyses etc. It positions immobile soft palate posterior and superiorly to narrow the palatopharyngeal opening for the purpose of improving oral air pressure and therefore speech.



MANDIBULAR DEFECTS

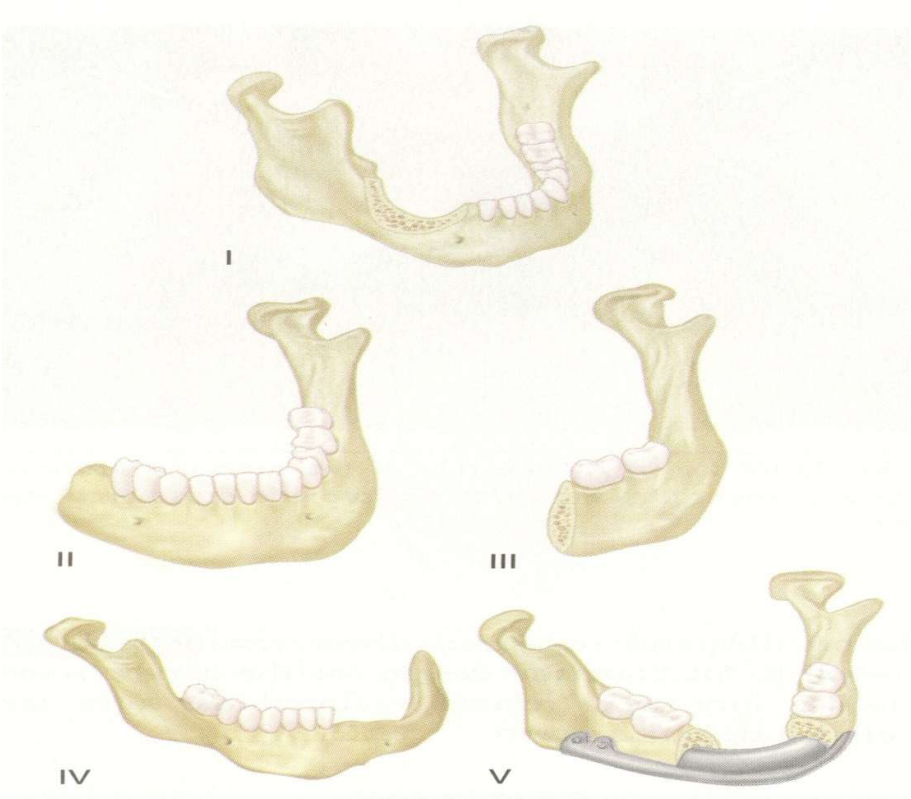
The mandible defects can be classified as

TYPE I RESECTION

In this inferior border of mandible remain intact and defect is only in alveolar process. The normal movements of mandible can be expected.

TYPE II RESECTION

The mandible is resected in region of second premolar and first molar along with the lower boarder. This is mandibular discontinuity defects. This type of defects causes movement problem which depends upon the size and location of defects.



The different types of prostheses can be given to patients with mandibulectomy defects depending upon the condition of remaining mandible and its mobility. The mandibulectomy prostheses are

Prosthesis with flange or flange prosthesis

Prosthesis with resin ramps

Prosthesis with double occlusal table

FACIAL PROSTHESIS

The facial prosthesis can be given in patients with extra oral defects. The extra oral prostheses are

Nasal prosthesis

Ear prosthesis

Eye prosthesis

DENTURE ADHESIVES

Definition: -

Commercially available, nontoxic soluble materials that can applied on the tissue surface of dentures to enhance

- Denture retention
- Stability
- Performance

Mechanism of action: -

Enhance retention by

- Optimizing interfacial forces by increasing the
- adhesion, cohesion and viscosity of saliva and
- minimizing the gap between the denture and basal seat
- They are more adhesive than saliva. The adhesives absorb the saliva and swells, flow under pressure and reduces the gap between denture and tissues.

Composition: -

- Salt
- CMC carboxy methyl cellulose (short acting)
- Polyvinyl methyl ether (long acting)

They hydrate in presence of water and adhere to the denture and tissues.

Indications: -

- In new denture wearers in the adaptive period
- In well-made denture do not satisfy a patient's expectations of retention & stability
- Very resorb ridges
- Xerostomia patient
- Maxillofacial prosthesis
- Patient with neurological disorders (Parkinson's disease)

Contra indications: -

- Faulty dentures
- Allergy to its constituents
- Alternative to relining/rebasing

Requirements to ideal denture adhesive: -

- Biocompatible and nontoxic
- Soluble in oral fluids after some time
- Easily remove clean and replace
- Not damage the denture base material/soft-liners
- Exabit antimicrobial properties
- Have long shelf life
- Inexpensive

DENTURE CLEANSING & DISINFECTING

Mechanical

- Brushing
- Ultrasonic units

Chemical

- Oxygenating agents
- Dilute mineral acids
- Enzyme containing materials

Oxygenating agents: -

Alkaline peroxide or percarbonate (powder & tablets)

Ingredients: -

Alkaline compounds, detergents, sodium perborate and flavoring agents

Mechanism of Action: -

Mixed with water sodium perborate decompose releasing peroxides. Peroxide further decomposes and release oxygen. This process breaks down, dissolve and floats organic compounds and kills microorganism from the denture.

Not effective in removing heavy calculus deposits. Some are not compatible with soft liners.

Hydrochloride solutions: -

- Sodium hypo chloride (diluted house hold bleach)
- 5% sodium hypo chloride in three parts of water (1:3)
- Immerse dentures for 10 minutes
- Not recommend for cast partial dentures (reacts with base metal alloys) cause corrosion and darkening of metal
- Prolonged use can discolour the denture base resins
- Also discolour the silicon base soft liners

Dilute acids: -

- Citric acid, isopropyl alcohol, hydrochloric acid or plain house hold vinegar
- Remove inorganic phosphate deposits (calculus deposits)
- Kills microorganisms
- May cause corrosion of some metal alloys

Enzyme containing denture cleaner: -

- Mutase and protease enzymes
- Reduce denture plaque
- Soaking and mechanical brushing

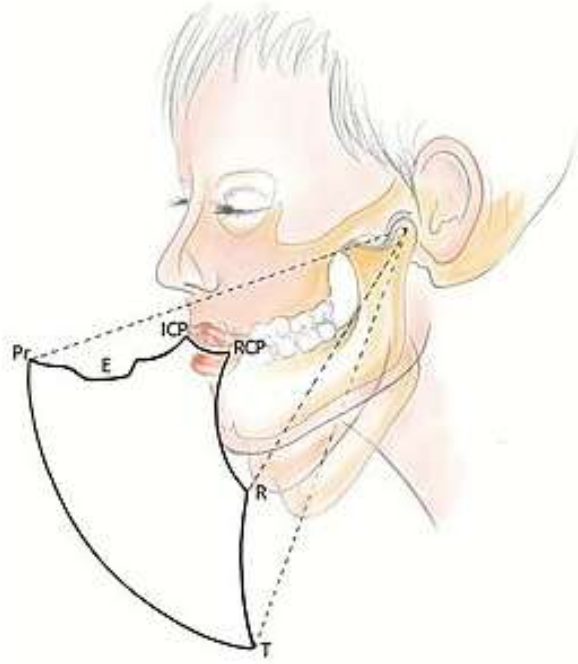
Microwave radiation: -

- To disinfect dentures
- 3 minutes at 650W
- No metal allowed in microwave

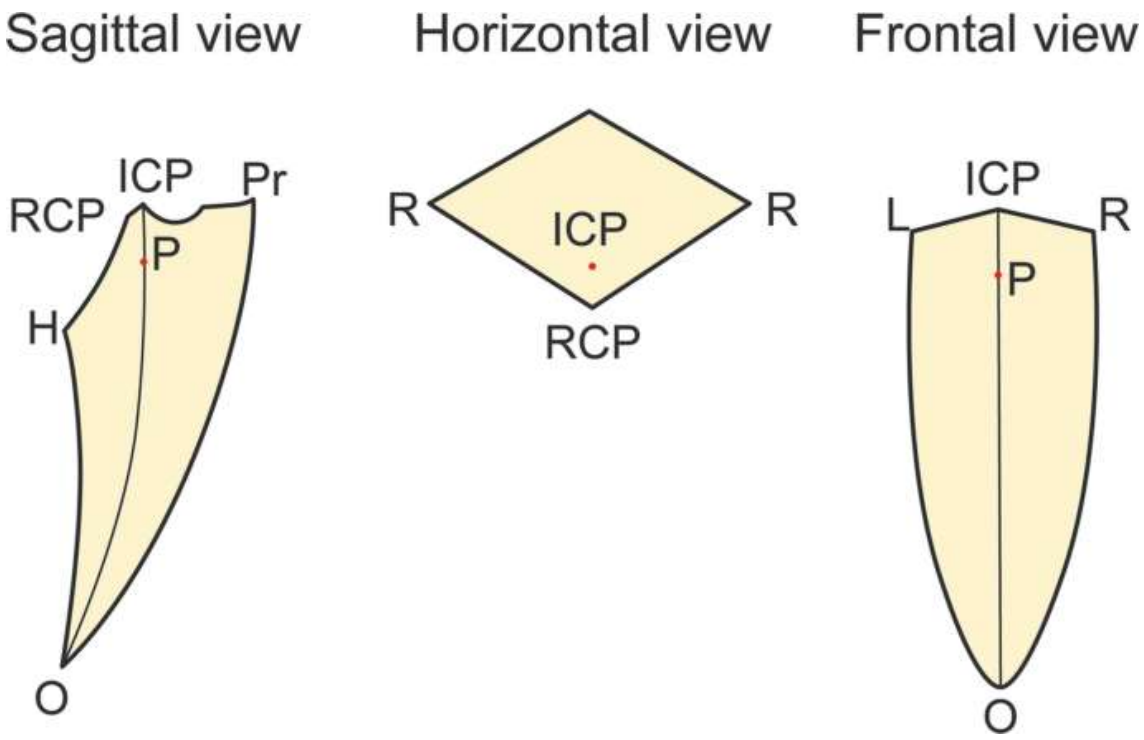
THE ENVELOPE OF MOTION (POSSELT'S ENVELOPE)

The envelope of motion is a diagrammatic representation of the mandibular border movements. Classically, those movements are carried out eccentrically; starting from the position of maximal intercuspation, the mandible describes an excursion movement until reaching maximal mouth opening. Literature states that beyond mandibular border movements limits, no movement is possible.

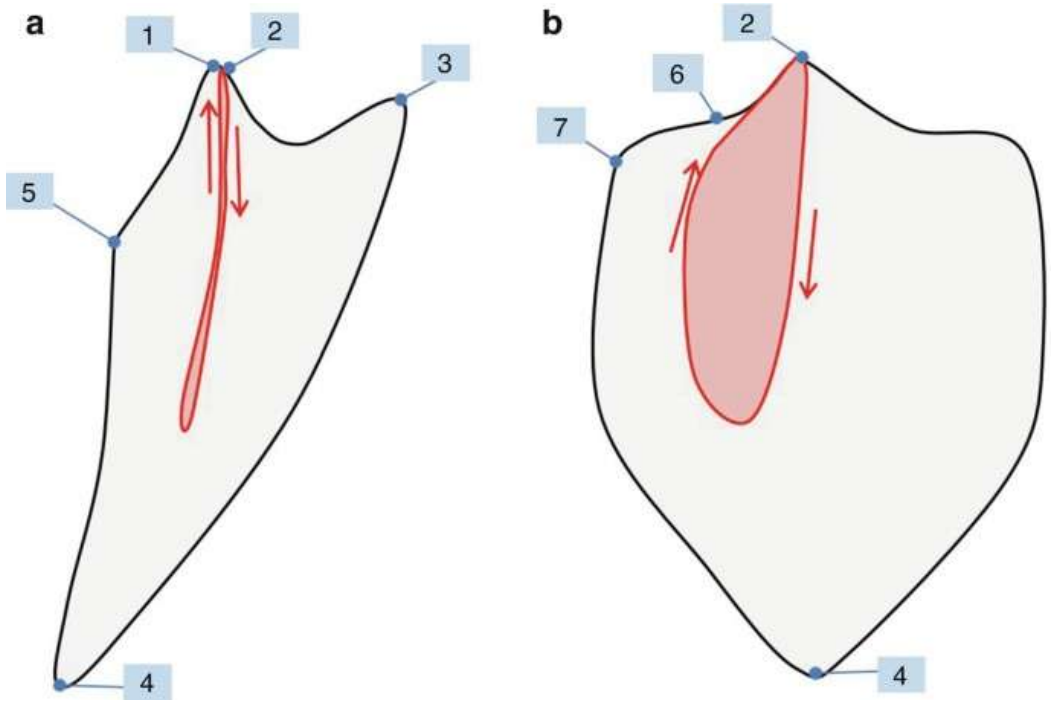
In order to understand the biomechanics of the mandible, it must be considered that mandibular movements are produced by a complex series of interrelated three-dimensional rotation and translation activities, involving the participation of several anatomical structures that is, temporomandibular joints, muscles and ligaments. Mandibular border movements (MBMs) describe the external limits of jaw movement, and it can be reproduced, unlike functional movements, which are not reproducible. Most of the functional movements start in a maximum intercuspation position (MIP). The jaw generally moves first to an eccentric position, such as maximum mouth opening (MMO), before initiating mandibular closure until maximum intercuspation position is reached.



1-Centric relation (RCR)
2-Maximum intercuspation (ICP)
3-Edge to edge position(E)
4-Maximum protruded position (PR)
5-Rotational path (R)
6-Maximum opening (translation T)



Functional limits



IMPLANT PROSTHODONTICS

IMPLANT PROSTHODONTICS

DENTAL IMPLANT

A dental implant is an alloplastic material surgically inserted into a residual bony ridge, primarily as a prosthodontic foundation.

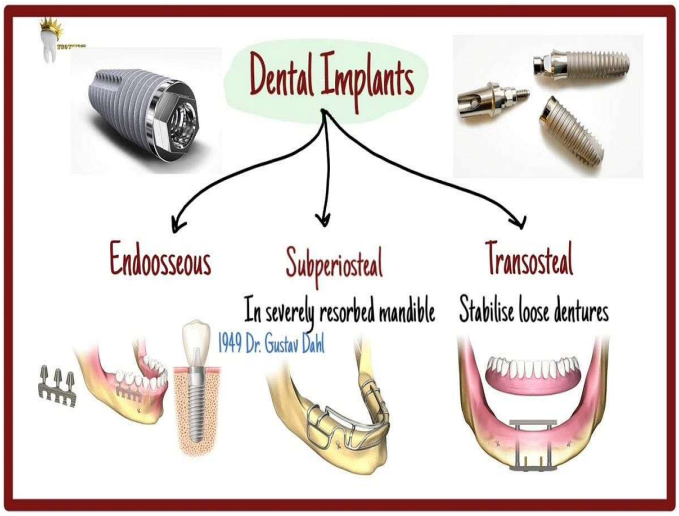
TYPES OF IMPLANTS

SUBPERIOSTEAL IMPLANTS

This implant is as a framework placed above the bone and under the mucoperiosteum. It is now very limited in use.

TRANSOSSES IMPLANTS

This type of implants crosses the bone and screwed on other side of bone. It can only use in very thin mandibles.



ENDOSSEOUS IMPLANTS

These implants have a root shaped body and inserted in the bone. In bone it retained by process of osseointegration. The osseointegration is process of bone deposition around implants without any fibrous tissue in between.

An endosteal or endosseous dental implant is designed for placement into the alveolar or basal bone of the mandible or maxilla while maintaining the body of the implant within the bone. The Endosseous implants are designed with a macro structure that optimizes initial stability and a microstructure, or surface texture, which promotes osseointegration. Similarly, the recommended surgical and restorative protocols are designed to promote and maintain primary stability and osseointegration of the implant.

There are two basic types of endosseous implants, blade form and root form.

Blade Implants

Blade implants are endosseous implants with a flat shape and are available in one-piece and two-piece designs. The original blade was constructed from a CrNiVa alloy, but titanium alloy, aluminum oxides, and vitreous carbon materials have also been used.

Cylinder Implants

A cylinder or press-fit implant is an endosseous design consisting of a straight cylinder that is pushed or tapped into the surgical osteotomy. Cylinder implants gained widespread
popularity because of their simple surgical placement protocol. Primary stability of these designs relies on a highly roughened surface texture to increase frictional resistance to dislodgement from the bone. Surfaces used for these implants included hydroxyapatite (HA), titanium plasma spray (TPS).

SCREW-SHAPED IMPLANTS

Screw-shaped implants, in which the implant body exhibits screw threads throughout most or all its length, have become the most commonly used implant design. Current designs feature improved primary stability and simplified surgical placement protocols. The original Brånemark implant was a parallel-walled design, featuring an implant body that maintained the same diameter throughout its length. Current designs feature a tapered screw design, in which the diameter of the implant body decreases toward the apex.

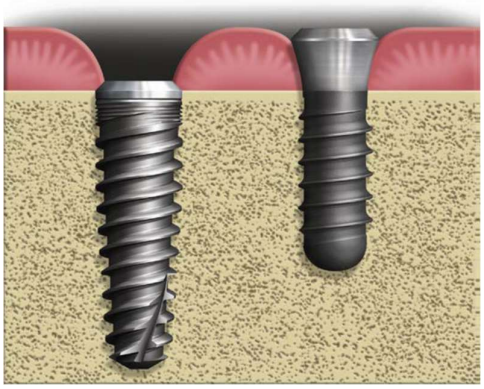
One-Piece versus Two-Piece

The two-piece implant design consists of an implant body, which provides anchorage within the bone, and a platform, which provides a connection. This connection is used to join the implant to various instruments and components and, finally, to an abutment or prosthesis. A one-piece implant has an abutment as part of the implant.

Small Diameter Implants

Small diameter implants (SDIs), often called mini-implants
They are screw-shaped implants with diameters from 1.8 to 2.9 mm and lengths ranging from 10 to 18 mm. The primary indication for SDIs is for treating patients with thin residual ridges that do not allow the placement of standard implants of 3.0 mm and greater and as a treatment alternative to lateral ridge.

Bone-Level versus Tissue-Level Implants



Most root-form implants can be described as bone-level implants, because they are designed to be placed at or near the bone crest. This design provides additional flexibility for creation of the soft tissue emergence profile of the implant restoration.
Implants that are designed for placement with the collar at or near the soft tissue margin are referred to as tissue-level implants. Tissue-level implants were developed to increase the distance of the implant–abutment interface.

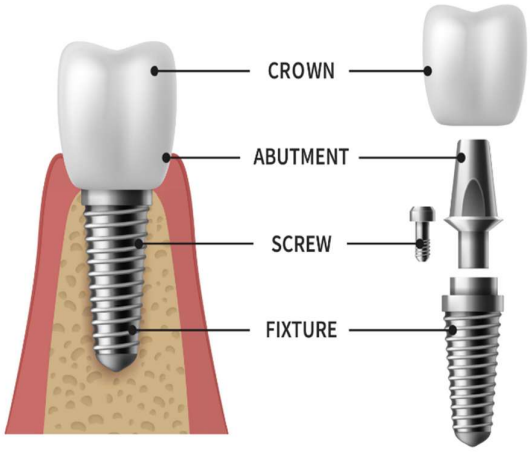
PARTS OF IMPLANT

Implant Fixture:
this is the main part that is surgically placed into the jaw bone, serving as a foundation.

Abutment:
this is a connector that links the implant fixture to the prosthetic tooth or crown.

Micro Screw:
this holds the components together.

Additional components:
other parts as a healing cap, locator attachment and various parts depending on different systems.



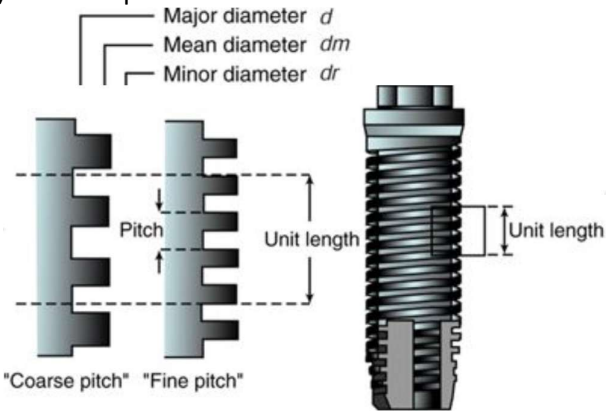
IMPLANT MACROSTRUCTURE

Implant macrostructure, or overall shape, is designed to optimize precise placement, initial stability within the bone, and distribution of forces within the bone. The predominating macrostructure for root-form endosseous implants is the screw shape, which includes the parallel-sided screw and the tapered screw. The parallel-sided screw was documented extensively by Brånemark and colleagues and was considered to be the standard design for many years. The surgical protocol for placing this implant shape included graduated drills of increasing diameter and usually ended with a tapping or thread-forming instrument that created threads that complemented the threads of the implant. Later, self-tapping implants were developed with a more aggressive apical shape that did not require this thread-forming step. For self-tapping designs, the surgical protocol normally dictated an osteotomy that conformed to the inner diameter of the screw, allowing the threads to cut their way in the bone during insertion.

The tapered screw design was developed to provide two advantages over the parallel-sided implant: increased initial stability and anatomic conformity. A tapered screw implant design can provide improved primary stability because it condenses bone in areas of reduced bone quality. Tapered screw implants also distribute occlusal forces to adjacent bone to a greater degree than parallel walled types. Additionally, the anatomic shape of this design makes perforation of the buccal and lingual bony walls less likely to occur and creates a more favorable opportunity to safely position the implant between adjacent tooth roots. The tapered design demonstrated greater primary implant stability than cylindrical implants. The tapered implants were also found to have better primary stability than parallel-sided implants.

IMPLANT THREADS

Dental implants come in several different thread configurations. The crest is the outer surface of the thread, and it joins the two sides of the thread. The diameter measured around the crest is the outer diameter (OD) of the implant. The root is the inner surface of the thread, and it joins the two sides of the thread. The diameter measured around the root is the inner diameter (ID) of the implant. The helix angle describes the angulation between the wall of the thread and the perpendicular axis. The pitch is the distance between two adjacent threads. Greater pitch is considered to be more aggressive in cutting through bone. The geometry of



the threads themselves influences stress distribution around the implant. Deeper threads seem to improve primary stability, particularly in bone of poor quality. V-threads, square threads, and buttress threads are dental implant thread forms are also use successfully. These threads serve to dissipate occlusal loads into the bone surrounding the implant; however, they differ in form, inherent strength, and in how they transmit forces. V-threads are strong, but they transmit more shear forces to the surrounding bone. Square-thread forms transmit occlusal forces with less shear force than V-threads. Buttress threads minimize shear forces in a manner similar to square threads, and they combine excellent primary stability with the best features of both V- and square-thread forms. The original Brånemark parallel-sided threaded implant was designed for placement into an osteotomy in which negative threads had been created during the surgical protocol using a screw tap instrument as a thread former. Later, self-tapping implants were introduced, primarily for use in bone of lower density to improve the primary stability of the implant. With a non–self-tapping implant, the osteotomy is prepared to a size approaching the outer diameter (OD) of the implant, whereas with a self-tapping implant the osteotomy is prepared to the approximate size of the inner diameter, ID, of the implant. Most implants in use today feature the tapered screw design that has a self-tapping feature, which eliminates the need for tapping in all but the densest bone.

IMPLANTS

ADVANTAGES	DISADVANTAGES	CONTRAINDICATIONS
Preservation of bone Esthetic teeth positioning Maintained vertical relation Proper occlusion Increased occlusal forces Improved mastication Increased stability & retention Improved phonetics Improved proprioception Reduced size of dentures	High cost of treatment Increased length of treatment High patient expectations Maintenance phase throughout life High level of patient Cooperation required Implant failure	Any systemic contra indication to minor oral surgery Uncontrolled diabetic mellitus Excess smoking Irradiation therapy Bone diseases (parathyroid) Bisphosphonate therapy Patient low intellectual level

TREATMENT PLANNING

Treatment plan is based on patient's needs desires and financial commitments.
All patients should not be treated with same restoration.

PATIENT SELECTION
Systemic condition
Mental condition
Financial condition
Oral condition (Quality & Quantity of bone)

SYSTEMIC CONDITION
Any contraindication to minor oral surgery
Uncontrolled diabetes mellitus
Smoking
Bone diseases

MENTAL CONDITION
High Patients expectations
Uncooperative patients
Any mental and psychological disorder

FINANCIAL CONDITION
Implant treatment is the most expensive treatment option. The patient financial condition effects the treatment planning from fully implant supported fixed prosthesis to conventional complete dentures.

BONE FOR IMPLANTS

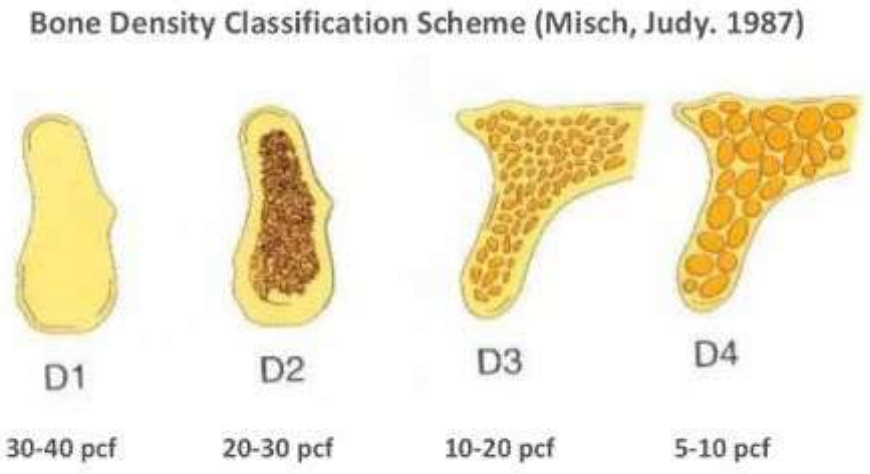
Quality (Bone Density) and Quantity (Available Bone) of bone in an edentulous site is a determining factor in treatment planning, implant design, surgical approach, healing time and bone loading during prosthodontic restoration.

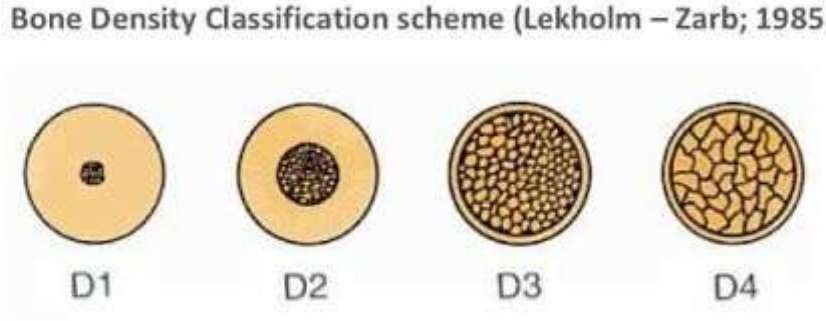
BONE DENSITY

Bone density is the quality of bone and depends on the ratio of cortical bone, cancellous bone and trabecular bone. Bone density is directly related to the strength of bone. The cortical bone is the strongest bone required for implant success. The increase percentage of cortical improves the bone quality while cancellous bone reduces the bone quality.
Bone density provides mechanical immobilization of the implant during healing. After healing it also distribute and transmit stress from the prosthesis to the implant bone interface. The mechanical distribution of stress occurs primarily where bone is in contact with the implant i.e. cortical bone. The open marrow spaces and fibrous tissues, as in cancellous and trabecular bone, don't distribute stresses. The bone implant contact is significantly greater in cortical bone than in trabecular bone.
The bone density is divided in four classes (D1 to D4) depending upon the presence of bone type as cortical and trabecular bone. The treatment plan may be modified by reducing the forces on the prosthesis or increasing the area of load bearing by increasing implants number, implant size and implant design from D1 to D4 bone.

BONE DENSITY CLASSIFICATION

Class	Bone Type	Location	Strength 1-10 scale
D1	Dence cortical bone	Anterior mandible	9-10
D2	Porous cortical Coarse trabecular	Anterior mandible Posterior mandible Anterior maxilla	7-8
D3	Porous cortical(thin) Fine trabecular	Anterior maxilla Posterior maxilla Posterior mandible	3-4
D4	Fine trabecular	Posterior maxilla	1-2

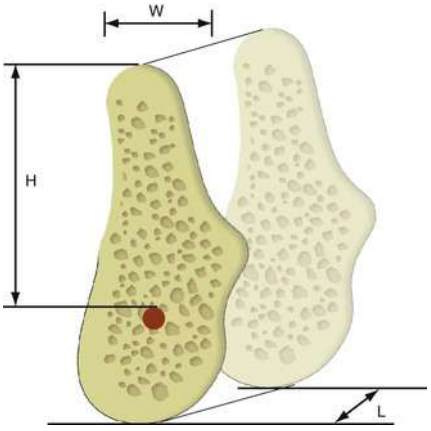




QUANTITY OF BONE (AVAILABLE BONE)

Available bone describes the amount of bone in the edentulous area for implantation. It is measured in width, height, length and angulation.

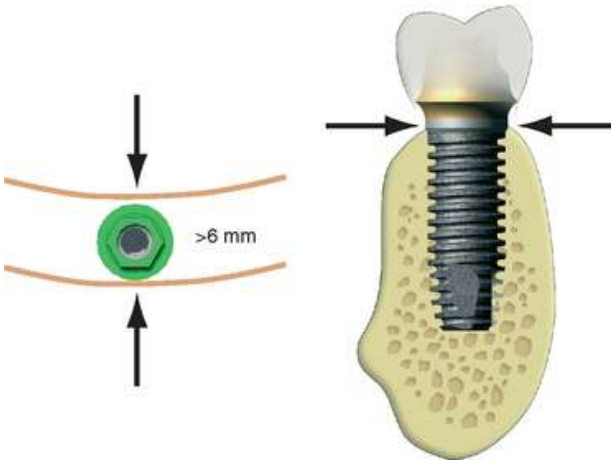
BONE HEIGHT



The height of available bone is measured from crest of the edentulous ridge to the opposing land mark. The anterior regions are limited by maxillary nares and inferior boarder of the mandible. The anterior regions of jaws have greatest height. The maxillary sinus and inferior alveolar canal limit the bone height in posterior regions. The mental foramen in lower 2nd premolar area also limited the available bone height. The maxillary canine region has the greatest height of bone. The available bone height in an edentulous area affects the both implant height and crown height. The crown height affects force factor and aesthetics. The bone height can be modified by bone augmentation and bone grafting.

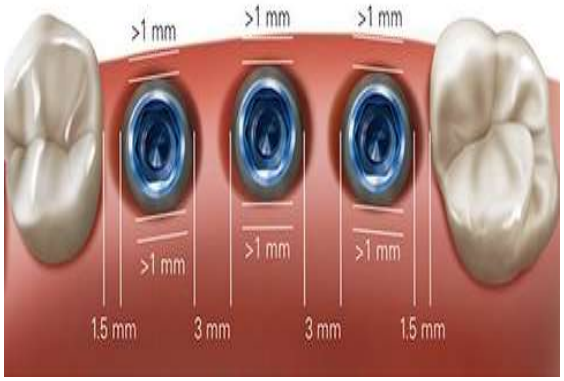
BONE WIDTH

The bone width is measured between the facial and lingual plates at the crest of the implant site. The crest of ridge is supported by wider base and bone width can be modified by crest osteoplasty. This increases the width but reduces the height. The width provides initial implant stability. The wider implants are preferable then longer one as they increase the bone contact area more than long implants.
Root form implants of 4mm diameter requires at least 6mm of bone width for sufficient bone thickness and blood supply around the implant.



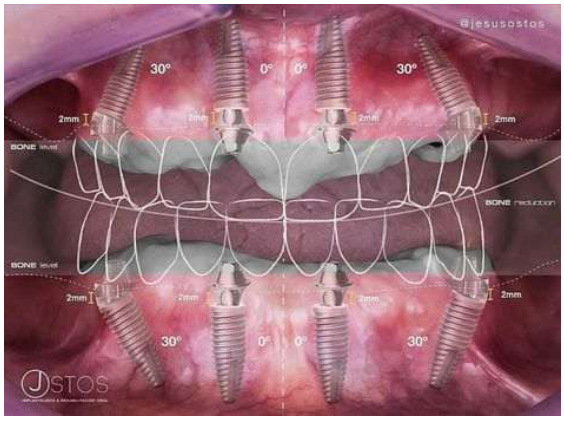
BONE LENGTH

The mesiodistal length of edentulous span is the length of bone. It is limited by the adjacent teeth or implants. As a general rule the implant should be at least 1.5mm away from an adjacent tooth and 3mm from adjacent implant. As a 5mm diameter implant should have at least 8mm of mesiodistal bone, so 1.5mm is present on each side of implant. A minimum of 7mm of bone is required for 4mm diameter implant.



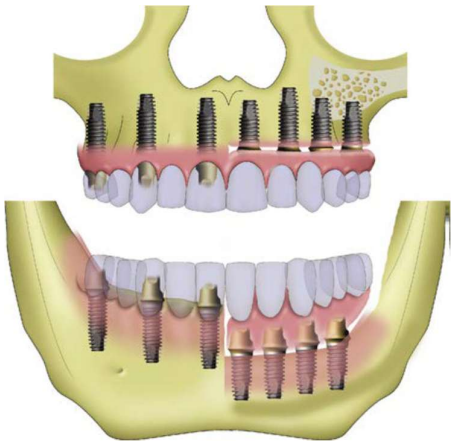
BONE ANGULATION

The initial bone angle represents the natural root angle in relation to occlusal plane.
In mandible the roots flare, so that anatomical crows are more lingually inclined in posterior region and labially inclined in anterior region.
In maxilla anterior teeth flare 12 degree labially. In the other areas the teeth are perpendicular to the curve of Spee and Wilson.
The implant placement is adjusted with the angulation of the bone in different regions so to transfer stress perpendicular to the bone.



CROWN HEIGHT SPACE (CHS)

It defines as vertical distance from the crest of ridge to the occlusal plane (it is near 15mm normally). It affects the appearance of final prosthesis and amount of lateral force on implant at crestal bone. It acts as a vertical cantilever. Esthetically the prosthesis has to replace lost tooth with the lost tissues. As bone height decrease it increases the crown height space and lateral forces to implants.

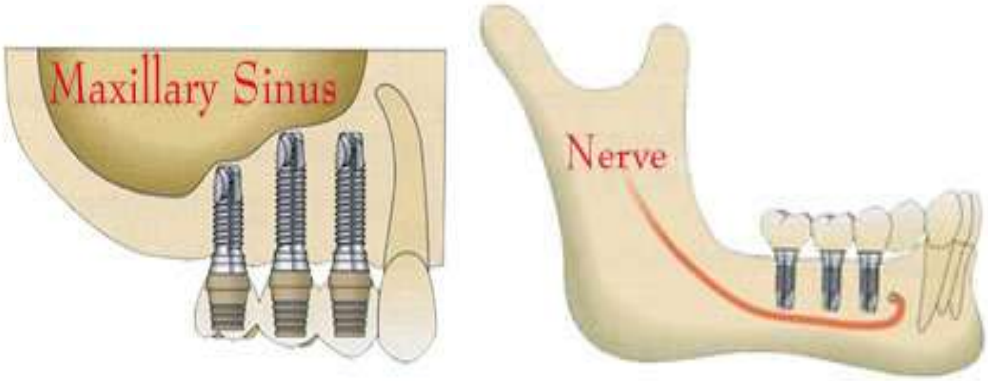


CLASSIFICATION OF AVAILABLE BONE

DIVISION	WIDTH	HEIGHT	LENGTH	ANGULATION	CHS
A	≥ 6mm	≥12mm	≥7mm	≤ 25^0	15mm
B	2.5-6mm	12mm	6mm	20^0	15mm
C	0-2.5mm	≤ 12mm	Edentulous	30^0	More 15mm
D	Severely atrophic	Flat	Edentulous	Flat	More 20mm

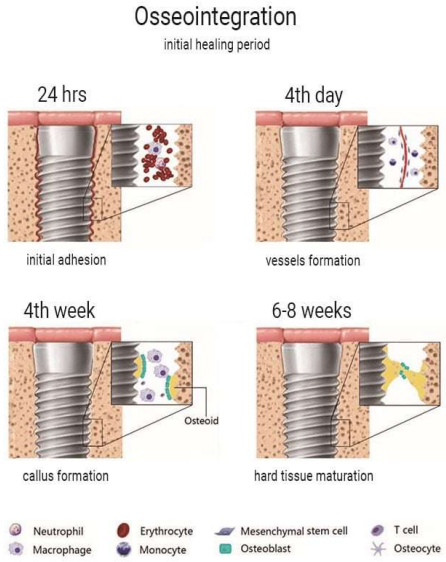
ANATOMICAL LANDMARKS

Maxillary sinus in maxilla needs evaluation before implant placement in posterior maxilla. Its approximation to the crest of ridge reduces the bone height for implant placement. Inferior alveolar canal reduces the bone height in posterior mandible. It also needs evaluation before implant placement. The mental foramen is the factor to be considered for implant placement in anterior mandible.



OSSEOINTEGRATION

It is defined as direct contact of living bone with the surface of an implant at light microscopic level of magnification.
The bond of an Osseo integrated implant with the surrounding bone is a biomechanical one resulting from bone growth into surface irregularities of the implant with a resultant 3-dimensional stability of implant.
This close contact of the bone and implant gives the implant fixation and stability and also distribute occlusal loads on a wider area of bone. This wider load distribution act as a natural root of tooth and preserve bone from resorption.
This osseointegration makes alloplastic implant to acts as a tooth root and support overlying prosthesis.
There are six factors which are required for reliable osseointigration.

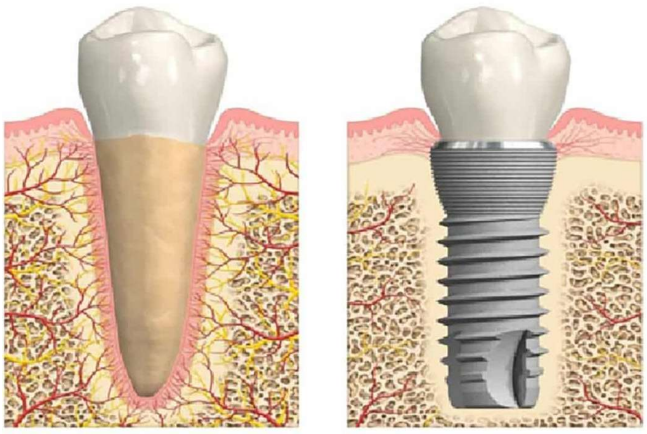


1.IMPLANT BIOCOMPATIBILITY

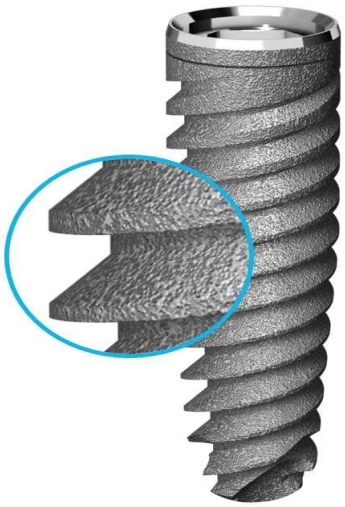
The implant material should have a capability of working in biological environment and promote bone deposition. The most commonly used implant material is commercially pure (PU) Titanium. Titanium is an inert material with body tissues, light in weight, soft and passively oxidized preventing any rusting. Zirconia and Aluminum oxide(ceramics) are also other materials but longe term studies are required.

2.IMPLANT DESIGN

The threaded surface of implant provides increased surface area of bone to deposit. The threads also engage the bone and provide mechanical bond. It gives initial fixation to implant and enhance osseointigration.



3.IMPLANT SURFACE

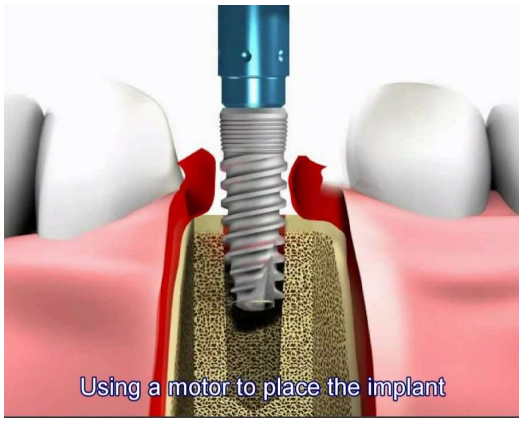


The microroughness is used to increase the bone deposition area as osseointegration is directly proportional to bone implant contact area. The implant surface can also be altered by deposition of calcium and magnesium ions or hydroxyapatite. These ions altered the bone deposition response in favorable way. This also increase microroughness. The spray of bone stimulating factors is also used and enhance bone deposition. Plasma coating and hydroxyapatite crystal coating also make a chemical bond between bone and implant surface.

4. HOST BED

Healthy implant site favors osseointegration. The patient age, history of irradiation, systemic diseases like diabetes, habits like smoking effects the osseointegration.
Old age does not cause poor implant results. While very young age is a relative contraindication to implants. The current general recommendation is to await completion of growth before implant insertion.
Smoking has been reported as a lower success rate with implants. The reduce blood supply due to vasoconstriction may be the reason of osseointegration failure. The diabetes has the same effects on healing.
Previous irradiation therapy is contraindication to implants. As the irradiation causes vasoconstriction to bone leading delaying healing. A 1-year delay after irradiation therapy has been recommended for implant placement.

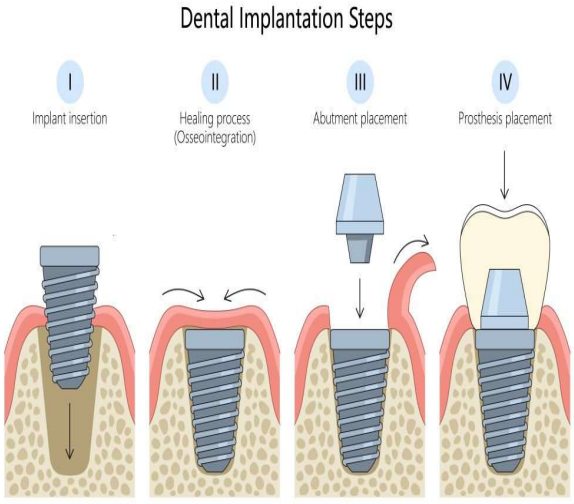
5. SURGICAL TECHNIQUES



Gentle handling of tissues at surgery is essential for proper osseointegration. The continuous and careful cooling is required during surgical drilling. High temperature during surgery causes the death of bone cell required for bone deposition. Drilling at low speed with graduated series of drills recommended. The proper drill geometry with intermitted drilling is required. Moderate level of insertion torque because high stress torque is causing stress concentration around threads of implant.

6.LOAD CONDITIONS

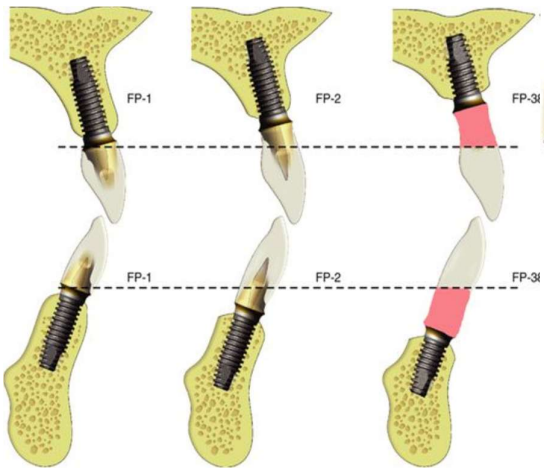
A two-stage implant insertion is recommended for good osseointegration. In this technique, in the first surgery implant is inserted and sutured the side. After 3-6 months the site is again open and the abutment attached. This will protect the implant during healing phase and promote osseointegration.
The immediate loading technique are also now recommended but they need high level of experience and skills.

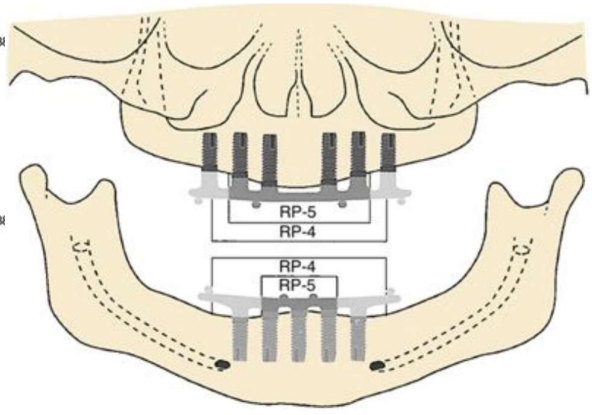


IMPLANT TREATMENT PLANNING FOR EDENTULOUS PATIENTS

Implant treatment planning for edentulous patient is depended on available bone, patient systemic conditions, patient's attitude and expectations and finances.
There are five options available for an edentulous patient mainly depending on the available bone. Three are fixed and two are removeable over dentures. (FP1, FP2, PF3, RP1, RP2).

PROSTHESIS	DESCRIPTION	INDICATIONS
FP-1	Fixed prosthesis, replaces only crowns, looks like natural tooth	Minimal loss of hard and soft tissues. Indicated in anterior maxilla for esthetics
FP-2	Fixed prosthesis, replaces crowns and portion of root. Crown appears normal in occlusal half but elongated in gingival half.	A moderate loss of bone and soft tissue in anterior maxilla. Looks like teeth with bone loss and gingival recession.
FP-3	Fixed prosthesis, replaces crown, root and gingival tissues.	High crown height due to bone loss by resorption or osteoplasty for implant placement. Has pink acrylic for soft tissues replacement and may have acrylic teeth.
RP-4	Removable prosthesis, overdenture completely supported by implants	Over denture supported by fixed bar with high level of bone loss.5-6 implants in mandible and 6-8 in maxilla are required.
RP-5	Removable prosthesis, overdenture supported by implants and soft tissues	Over denture combining implant and soft tissue support. Reduced cost, good bone in posterior region, may be converted to RP-4 in future.





IMPLANT SUPPORTED OVER DENTURES

Traditionally over dentures rely on remaining natural teeth to support the prosthesis. The location of these natural abutments is variable and compromised with bone loss and periodontal diseases. For an implant supported complete over denture, the implants can be placed in planned positions, specific sites and their numbers can be controlled by restoring doctor.

There are several advantages of implant over dentures. The minimum bone resorption occurs in anterior residual ridge with the placement of implants. Bone loss dictates the appearance of the inferior third of the face. A maxillary over denture provides improved support for the lips and soft tissues of the face. The teeth can be placed in most esthetic position without any restriction to the relation of the atrophic crest because the stability provided by the implants does not depend on tooth position on the crest of the ridge.

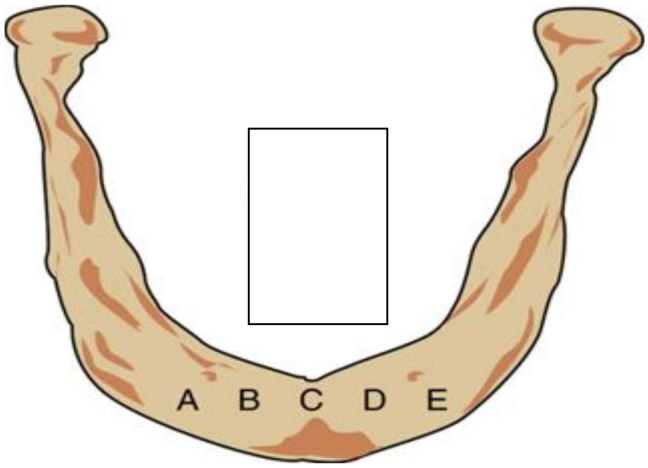
The implant over denture may reduce the amount of soft tissues coverage and extension of the flanges. This is especially important for the new denture wearers, patient with tori and patients with low gaging reflex. Over denture may be removed at the bed time to reduce effects of nocturnal parafunctions.

When coast is a matter the number of implants can be reduced or increased from one to as high as six. The implant placement can also be split in future as patient's financial improvement.

Mandible implant over dentures is highly recommended as high level of problems of complete dentures as lack of retention, stability, difficulties in speech, soft tissue abrasion and low masticatory efficiency.

MANDIBLE IMPLANT SUPPORTED OVER DENTURES

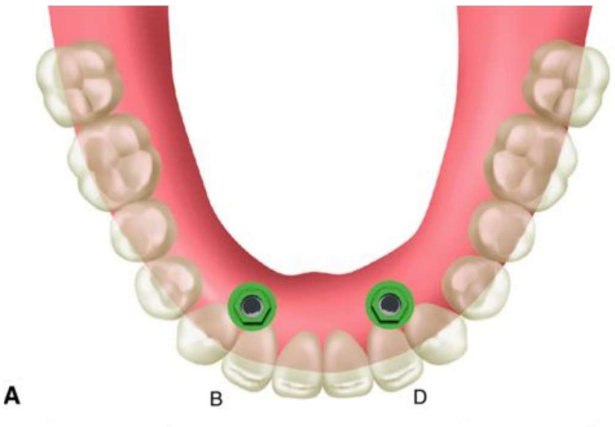
The greatest available height of bone is located in the anterior mandible between the mental foramens. This region also presents optimal density(D1) of bone for implant support. By placing the implants in anterior region, the anterior forces resisted by implants whereas posterior forces may be directed on the soft tissues as the mandible buccal shelf. The available bone in the anterior mandible is divided into five equal columns of bone as potential implant sites. Labeled A, B, C, D, E. starting from patient fight side between the two mental foramens. Regardless of the treatment option, all five implant sites should be mapped at the time of treatment planning and surgery. In this way patient always have option to obtain additional implant support in future. If an implant complication or failure occurs the preselected option site permit corrective procedure as new implant placement.



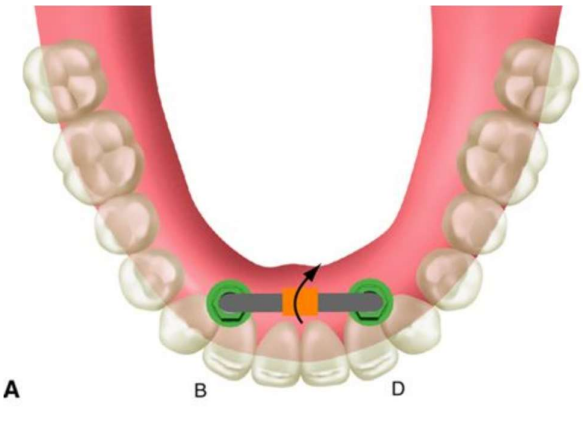
The mandible implant over dentures option is classified in five classes as OD-1 to OD-5, depending on the number of implants from 2-6 based on patient's oral conditions and financial conditions.

IMPLANT SUPPORTED MANDIBLE OVER DENTURES OPTIONS

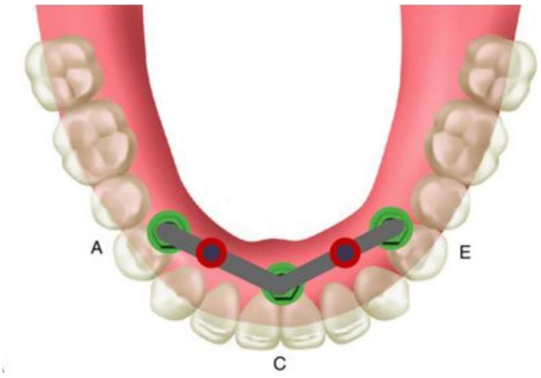
OPTION	SELECTION CRITERIA	IMPLANT LOCATION
OD-1	Anatomical conditions good to excellent U shape posterior ridge form Patients desire of retention Low cost, good hygiene Tapered arch farm Future Additional implants option	Implants in B and D location In depended of each other
OD-2	Anatomical conditions good to excellent U shape posterior ridge form Patients desire of retention, Affording patient No additional implant required within 3 years	Implants B & D location Joint with rigidly each other
OD-3	Anatomical conditions average U shape posterior ridge form Patients desire of more retention and stability Cost moderate factor	**A**. Implants A, C and E position joined by bar, with good posterior ridge form **B**. B C D position joint by bar with poor posterior ridge
OD-4	Moderate to severe problems with dentures Need to decrease bulk of prosthesis Inability to wear traditional prosthesis Posterior bone loss, Posterior sore spots Problems with function and stability	Implants at A, B, D & E joined by bar 10mm distal cantilever
OD-5	Moderate to severe problems with dentures Need to decrease bulk of prosthesis Inability to wear traditional prosthesis Posterior bone loss Problems with function and stability, sore spots Moderate to poor posterior anatomy Lack of retention stability, Speech difficulty More demanding patient type	Implants at ABCDE joined by bar, 15mm distal cantilever



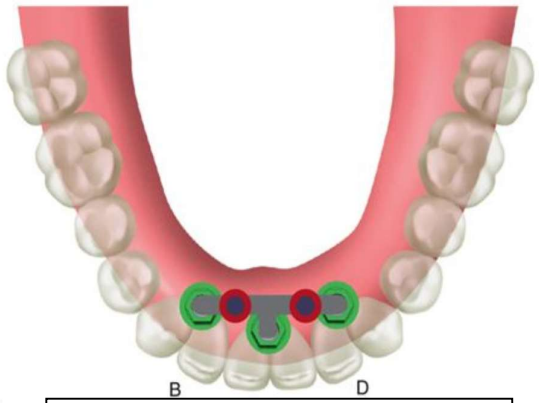
Over denture option 1



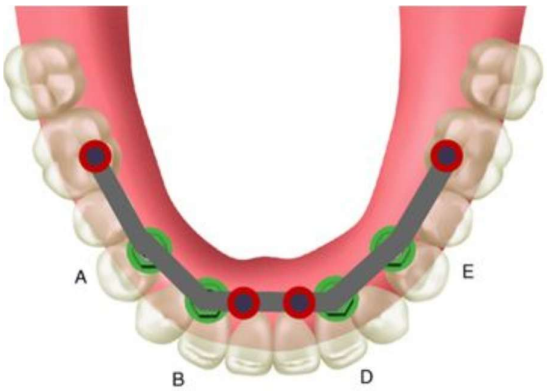
Over denture option 2



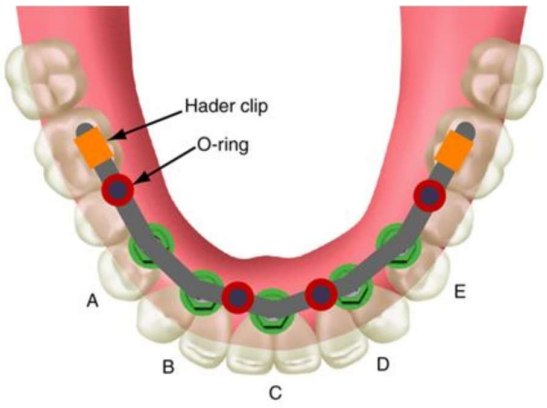
Over denture option 3-A



Over denture option 3-B



Over denture option 4



Over denture option 5

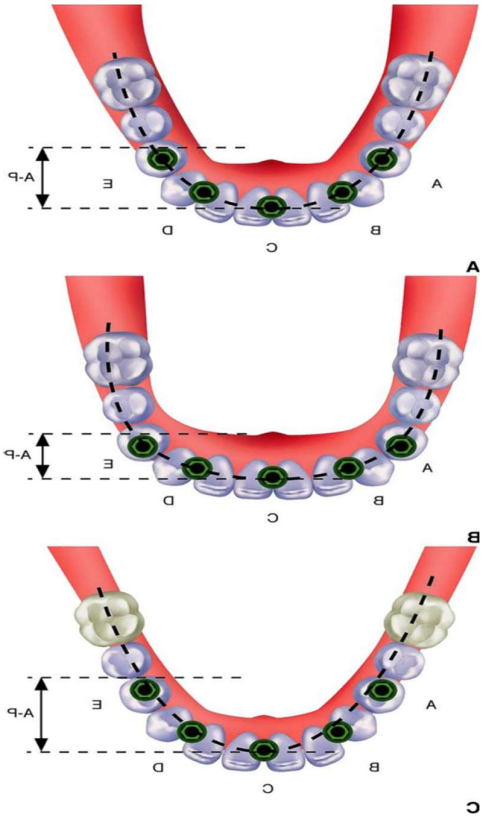
IMPLANT FIXED MANDIBLE PROSTHESIS OPTIONS

A fixed restoration provides the psychological advantage of acting and feeling similar to the natural teeth, whereas an overdenture remains a removable prosthesis.
Removable implant prosthesis requires greater maintenance and exhibited more frequent prosthesis related complications than fixed prosthesis. A mandible overdenture often trapes food below its flanges similar to dentures. The contours of a fixed prosthesis are less prone to trap food. The increase number of implants affects the cost of fixed prosthesis. Whenever conditions and favorable and cost is no problem, a fixed restoration is preferable.

MANDIBLE MEDIAL MOVEMENTS

The dimensional changes of the mandible occur during jaw activity as a result of masticatory muscles pull. The mandible between the mental foramens is stable, not affected by muscles contraction. However distal to the foramen mandible exhibits considerable movements towards the midline on opening. This movement is caused by the attachment of medial pterygoid muscle on the medial side of ramus of mandible. The mandible flex inside whenever mouth opening occurs.
Whenever implants splinted together posterior and anterior to the foramens causes posterior implant loss in full arch mandible prosthesis. The body of mandible also flexes more when size of bone decreases, so in resorb ridges more flexion occurs. So, the splinting of implants from one side to other side posterior to foramens is contraindicated. This problem can be solved by

1. The only one side of the implants can be splinted with anterior implants together.
2. The three individual prostheses are highly recommended.



ANTERIO-POSTERIOR DISTANCE/ A.P DISTANCE/ A.P SPREAD

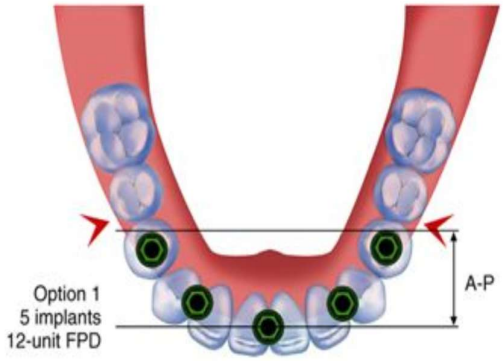
The distance from the center of the most anterior implant to a line joining the distal aspect of the most distal implants on each side is A.P distance or A.P spread. This distance guides the extension of distal cantilever of the arch bar connecting the implants. As a rule, in the mandible the distal cantilever should not extend more than 2.5 times of the AP distance. In maxilla it should not exceed 1.5 times of the AP distance.
Arch form also affects the AP distance. A tapering arch form has greatest AP distance (more than 8mm), the ovoid arch form has medium AP distance (6-8mm) while square arch form has least AP distance (2-5mm).
The cantilever is not indicated for three implants only five or more implants cab bear the posterior

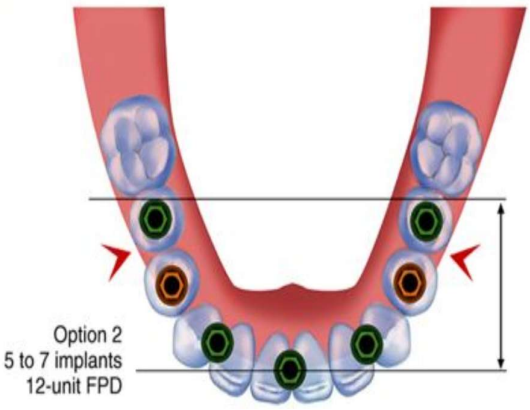
cantilever. The narrow implants cannot bear cantilever whereas wider implants can support a greater cantilever.
There are five treatment options for fixed mandible prosthesis.

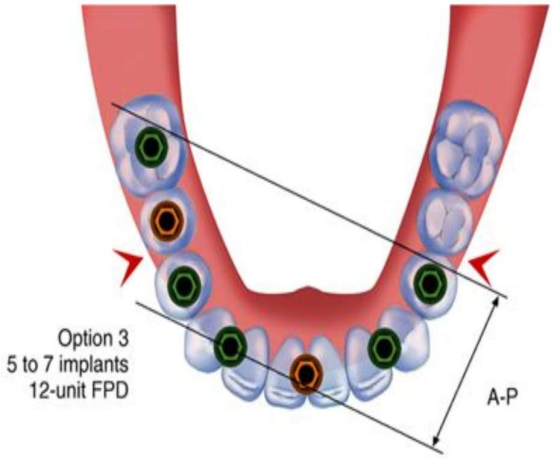
TREATMENT OPTIONS FOR FIXED MANDIBLE PROSTHESIS

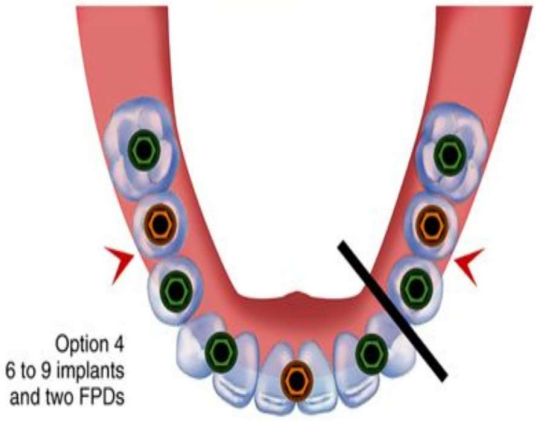
TREATMENT OPTION	DESCRIPTION	INDICATIONS
TO 1	4-6 implants anterior to the mental foramens, splinted together, distal cantilever for posterior teeth	Patient will low force factor as wearing upper denture, abundant anterior bone, crown height is less than 15mm, tapered or ovoid arch form.
TO 2	Additional implants placed above the mental foramens, 5-7 implants, increased the surface area, AP distance also increased, cantilever also reduced as last implant placed one tooth distal than TO 1.	Wider bone available above the foramen, shorter but wider implants placed. Key implant positions 2nd premolars, canines, central incisor or midline, two optional implants at 1st premolar positions.
TO 3	Implant can be placed on one side at 1st molar or 2nd premolar position with anterior 4-5/5-7 implants, one side cantilever.	Reduce cantilever only one side, with same number of implants TP2, available bone should be good at least in one posterior region.
TO 4	Bilateral posterior implants with anterior implants. One side implant splinted with anterior implant. Other side splinted together	Greater force factor, poor bone density. Elimination of cantilever, two-unit prosthesis, abundant bone in posterior region, increased cost.
TO 5	Three independent prostheses supported by implants, canine to canine and 1st premolar to 1st molar on both sides.	Independent prosthesis allows mandible flexure. Recommended in parafunctions habits with severs force factor, greater number of implants up to nine, increased cost

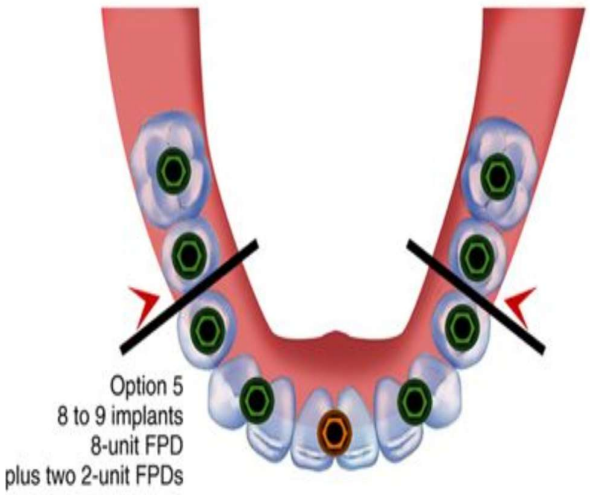
TREATMENT OPTIONS FOR FIXED MANDIBLE PROSTHESIS

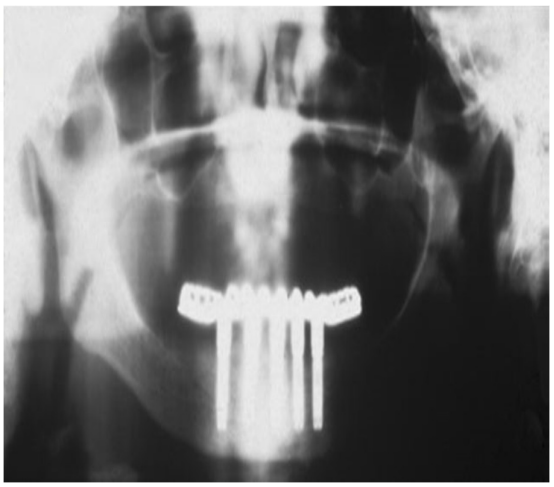












OPG showing cantilever on both side posterior to implants

MAXILLARY IMPLANT SUPPORTED PROSTHESIS

Maxillary dentures are usually better tolerated than the mandible dentures. So, in many treatment plans initially concentration is given on mandible denture. Once the patient has experienced a stable and retentive implant supported mandible prosthesis than maxillary implant prothesis is advised.
Implant treatment planning for maxilla is commonly divided in two segments anterior and posterior. As anterior and posterior segments both have different biomechanical factors, anatomical limitations, bone quality, esthetics and functional conditions.

TREATMENT PLANNING FOR ANTERIOR EDENTULOUS MAXILLA

Several factors affect the condition of anterior maxilla and may result in decrease implant survival rate. The facial cortical plate of premaxilla is thin over the roots and may be resorbed from periodontal diseases or fracture during extractions. The facial bone plate also rapidly resorbed during initial bone remolding. As a result, the anterior residual ridge migrates to a more palatal position. Initial denture wearing also contributes in this bone resorption.
In maxilla, as compared to mandible, the bone remains narrow till the floor of the nose and osteoplasty during implant surgery converts Div. B bone in Div. C-D bone. Therefore, bone augmentation is more required in anterior maxilla. In anterior maxilla bone is thin porous on labial aspects, very thin porous cortical bone on the floor of nasal and sinuous regions and more dense bone on palatal region, is available.
In the premaxilla, esthetics and phonetics dictates that the replacement teeth be placed t or near their original positions so a cantilever from the implant and residual ridge is required. This facial cantilever results in increase movements load at the implant crestal region and often leads to localized crestal remolding, bone loss and soft tissue recession and exposing the implant body.
From all this and biomechanical perspective, the implant restored anterior maxilla is the weakest section compared to the other regions of mouth. Therefore, more careful planning is required in this region considering all factors of force esthetics and patient's expectation.
Guidelines for anterior maxilla implant restoration

MAXILLARY LIP POSITION

The maxillary lip position should be recorded as by conventional method on occlusal wax rims. The labial position of the lip in relation to the premaxilla is the primary criteria to determine whether a fixed restoration, a bone graft and fixed restoration or a overdenture is indicated. When the labial position of the wax rim is 5mm or more forward to the residual ridge a bone graft prior to the implants is required for a fixed restoration. The maxillary anterior region with loss of all anterior teeth and bone loss, without bone graft, is often restored with an overdenture or FP-3 prosthesis.

KET IMPLANT POSITIONS

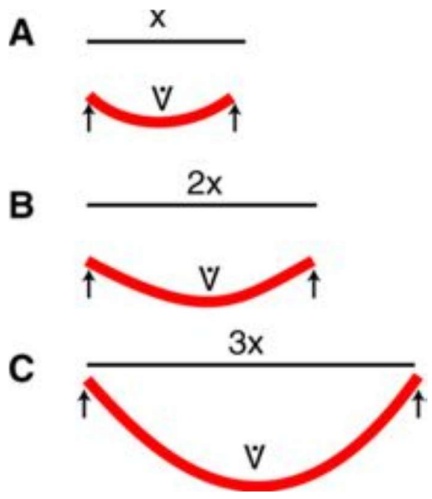
An important parameter in treatment planning is to provide adequate biomechanical position and surface area of implants to support for the load transmission to the prosthesis. There are key implant positions in maxilla some are more critical than others in regard of force reduction. There are four rules/guidelines for key implant positions.

1- No cantilever

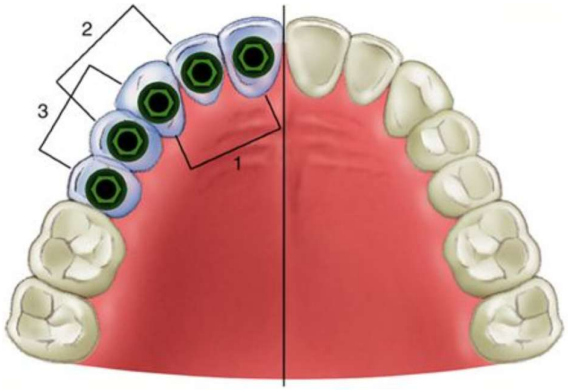
The first rule for ideal key implant position is that no cantilever should be designed in the prosthesis. Cantilevers are force magnifier to the implants, abutment screws, cement or prosthesis screws and implant-bone interface. The parafunctions enhance these problems. Therefore, the ideal key implant positions include the terminal abutment positions when adjacent teeth are missing.
The length of cantilever is directly proportional to the amount of the additional force placed on the abutments of the prosthesis. As a result, any part of the implant system is at an increased risk of biomechanical failure. A cantilever restoration on multiple implants may be compared with a class I lever. The extension of prosthesis from the last abutment is act as effort arm. The increase in length of cantilever magnifies the forces to all the abutments supporting the prosthesis.
The only exception is the lateral incisor cantilever. The anterior bite force is lowest in central and lateral incisors position. The elimination of occlusal contacts on pontic further reduce the risk of over loading.

2- No three adjacent Pontics

In most prosthesis design three adjacent pontics are contraindicated just as on natural teeth.
All pontic spans between the abutments flex under load. The greater the span between the abutments the greater the flexibility of the metal in the prosthesis. The greater the load the greater the flexibility, the greater the risk of porcelain fracture, uncemented prosthesis and abutment screw loosening. The metal flex is directly proportional to the cube of the distance between the abutments.
The span of pontics in the ideal treatment plan should be limited to the size of two premolars i.e. 13.5 to 16mm.



3- Canine and 1st molar sites



Canine is the key implant position whenever canine is missing with adjacent two teeth. As the canine restoration with fixed prosthesis is always at greater risk as the adjacent teeth are the weakest teeth in the arch. A conventional fixed prosthesis is contraindicated in this case when canine is missing with adjacent two teeth. The implant prosthesis is always recommended when canine is missing with

1- 1st premolar, canine and lateral incisor
2- 2nd premolar, 1st premolar and canine,
3- canine, lateral incisor and central incisor.

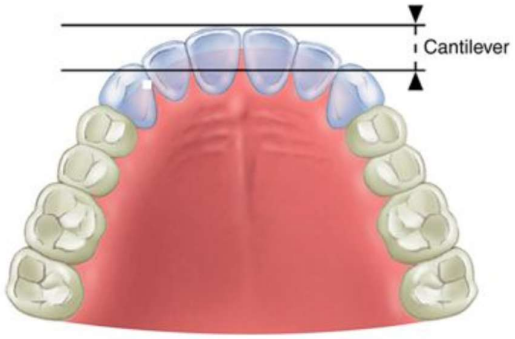
The 1st molar is also a key implant position when three adjacent posterior teeth are missing. The bite force doubles in molar region as compared to premolar region. In addition, the edentulous span of missing molar is 10 to 12mm compare with premolar is 7mm. as a result, when three or more adjacent teeth are missing including the 1st molar, the key implant position includes terminal implant and 1st molar implant.

4- Key implant positions

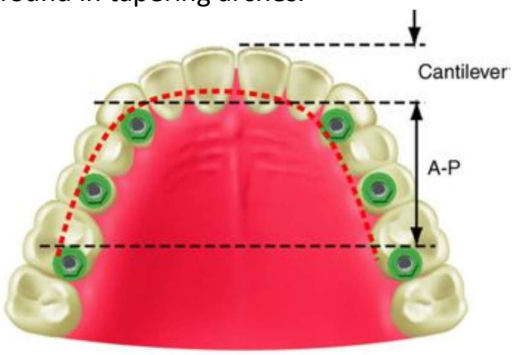
An arch may be divided into five segments similar to an open pentagon. The two central and lateral incisors are one segment; the canines are independent two segments and premolars and molars on both sides are two segments. Each segment should have one implant. Key implant positions are often not enough support for the implant restoration, unless all force factors are low and bone density is good. Therefore, additional implants required other than key implant positions.

At least one implant should be placed in each of the five sections missing teeth and then splinted together when replacing multiple adjacent teeth in the maxilla. At least three implants are usually required to replace the anterior six missing teeth in maxilla, one in each canine position and one in one of four incisors positions.

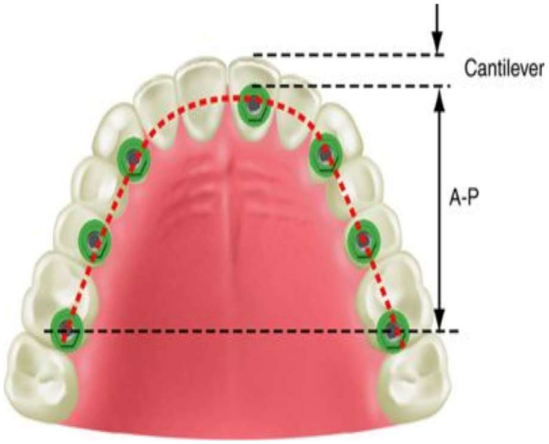
PREMAXILLA ARCH FORM

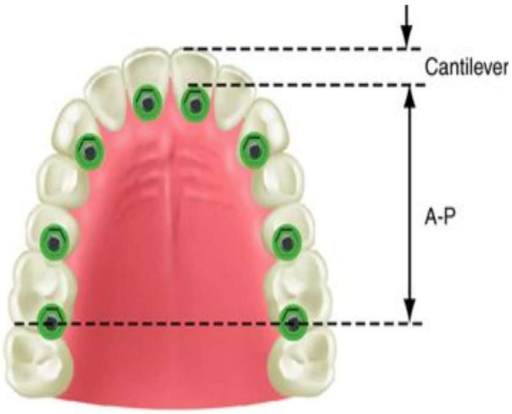


The dental arch form in maxilla influences the treatment plan. The dental arch form in maxilla is determined by the distance between two horizontal lines. The first line is drawn from one canine tip to other side canine cusp tip. This line bisects the incisive papilla. The second line is drawn parallel to first line, along the facial position of the anterior teeth. When the distance between there lines is less than 8mm the arch is square. The ovoid arch has 8-12mm distance while greater than 12mm distance found in tapering arches. This distance is the anterior cantilever which is least in square arch and largest in tapering arch while ovoid arch comes in between. This anterior cantilever affects the number of implants in anterior maxilla.



In square arch two implants in canine regions are sufficient to replace anterior six teeth when force factor is low. In ovoid arch three implants are required two canine positions and one central incisor position. The tapering arch needs two more implant in central incisor region other than two in canine regions.





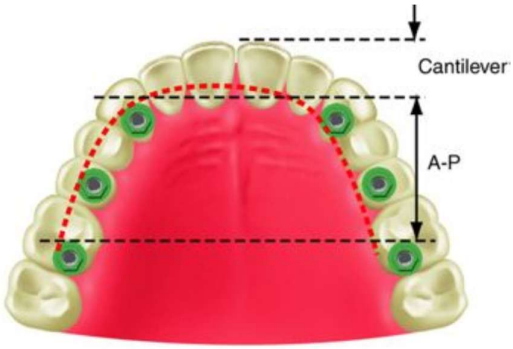
COMPLETE EDENTULOUS MAXILLA TREATMENT PLANS

FIXED IMPLANT SUPPORTED RESTORATIONS

The maxillary bone tends to be poor quality and volume tends to present several biomechanical disadvantages. It is suggested that to compensate for poor local conditions, a greater number of implants should be planned, along with the greater A-P distance. Therefore, there is usually a need for sinus graft and premaxilla reconstruction to restore the edentulous maxillary arch. There are guild lines for the number of implants for a fixed implant restoration depending on the shape of arch.

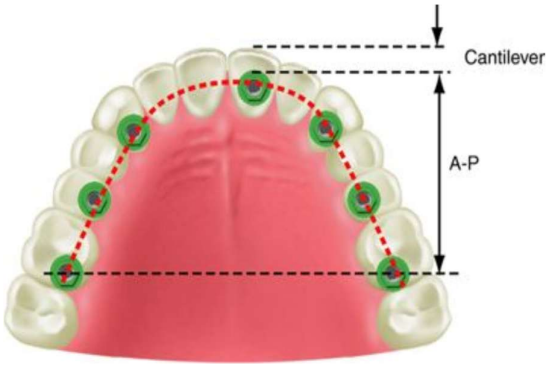
Square arch

A square arch form can use minimum of six implants. They are, bilateral canine positions, bilateral premolars position and bilateral 1st molar sites. The 1st molar sites in a complete maxilla usually require sinus lift, because most edentulous maxillary posterior regions are inadequate in height.



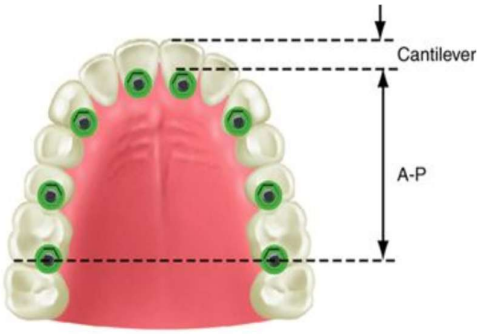
Ovoid arch

The minimum number of implants for a ovoid complete edentulous maxilla for fixed or RP-4 prosthesis is seven. The suggested locations are, at least one central (or lateral) incisor position, bilateral canine position, bilateral premolar positions and bilateral distal half of the 1st molar positions. These seven implants should be splinted together with a bar to function as one arch. These implant position creates greater distance between implants to allow for greater implant diameter.



Tapering arch

In tapering arch form minimum number of implants is eight. The two implants in central or lateral incisors sites, two bilateral canines, bilateral premolars and bilateral molars sites. When force factors are greater than usual or bone density is poor the additional implants should be used in any of the arch form.

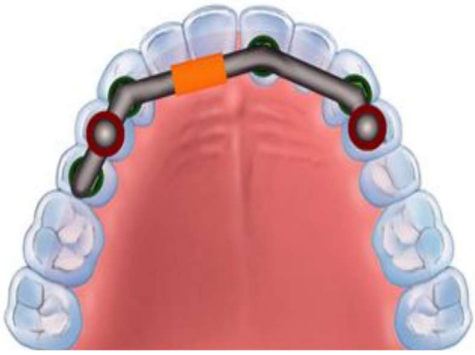


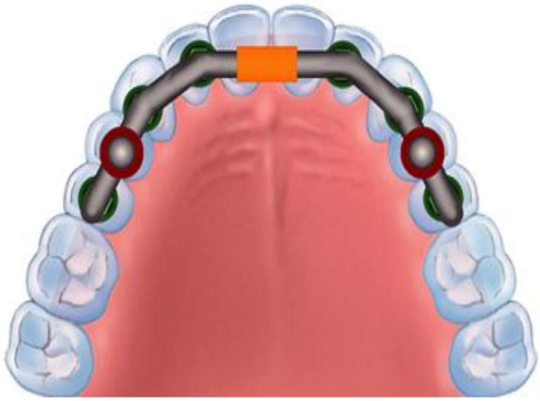
IMPLANT SUPPORTED MAXILLARY OVERDENTURES

The bone loss in anterior maxilla increasre the crown height space (CHS). In removeable prosthesis this space is easily accomadated by the flanges of the dentures. In fixed implant prosthesis this high CHS sesults increased moment forces on implants and increased risk of component and material fracture because the greater length of prosthesis is required for lip support. These problems are noted specially on cantilever portion of fixed prosthesis, in addition increased CHS incrases the weight and the cost of the prosthesis. To provide additional support to the maxillary lip two options are available.

1- A bone graft to the premaxilla
2- A maxillary overdenture with a labial flange

The primary advantage of implant overdenture compared with fixed prosthesis is the ablity of a flange for maxillary lip support due to increased CHS. Only two treatment options are available for maxillary overdenture as compared to mandible overdenture. The diffderence is due to primarly to biomechanical disadvantages of maxilla to the mandible. Independent implants are not an option because bone quqlityand force direction are severely compromised in maxilla. Two options are limited to RP-5 restoration with 4-6 implants and posterior soft tissue support and RP-4 restoration with 7-10 implants completely implant supported over denture.

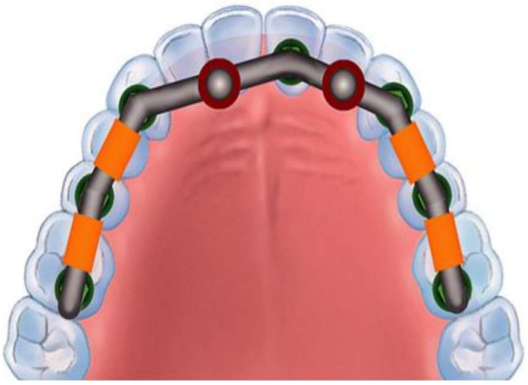




MAXILLARY RP-5 IMPLANT OVERDENTURE

The major advantage of RP-5 is maintanance of anterior bone and a less expensive treatment option than RP-4. As posterior implants are not required so no need of sinus lift operations. This option may be used a transition towards RP-4 in future. Four to six implants are recommended for RP-5 in which at least three in the anterior maxilla. The key implants are positioned in the bilateral canine regions and at one central incisor region (or two in lateral incisores region) and other implants placed in 1st or 2nd pemolar regions. The implants are always splinted with a rigid bar. There is no distal cantilever and the bar desgn should follow the dental arch but slightly lingual to the maxillary anterior teeth. The maxillary RP-4 prosthesis is designed exactly as complete denture with full palatal coverage and flanges.

MAXILLARY RP-4 IMPLANT OVERDENTURE



The second option is maxillary over denture RP-4 fully implant supported. This option is prefered because it maintanes greater bone volume and provide improved security and confidance to optient than RP-5 restoration. Howere the cost is similar to fixed restoration. Seven to ten implants are recommended for RP-4 restoration. Key implant positions are in bilateral canines and first molar positions. These positions usually required sinus graftsin the molar position. Bilateral premolars prefebly in 2nd permolar position ant at least one implant between th canines is required. One addition implant in premaxilla may be added in tapering arch. Two 2nd molar implants for greater force factor case may be added. These implants splinted together with rigid bar.

TREATMENT PLANNING IN POSTERIOR MAXILLA

Local anatomical conditions of edentulous residual ridge in the posterior maxilla may be unfavourable for the impant placement. The dentate maxilla has a thiner cortical plate on the facial compared to mandible. The trabicular bone of the posterior maxilla finer than the other dentate regions. The loss of maxillary positior teeth result in an initial decrease in bone width at the expence of buccal cortical plate.the wirdth of posterior maxilla dereases at a faster rate than any other region. The ridge peogresivly shifts towards the palate. This will result in the buccal cusp of final restoration often cantilever buccaly for esthetics reasons.
The crown height space should be evaluated before implant placement. The crown height space shlould be greater than 8mm. In case of less CHS the gingivectomy, osteoplasty or posterior osteotomy of posterior alveolar process are recommanded.
Ther are other factors which affect the treatment planning in posterior maxilla as.

Expension of the Maxillary sinus

The maxillary sinus mantains it size while the teeth are present. An expension of sinus occures with the loss of posterior teeth. The antrum expend in both laterala nd inferior direction. The dimension of available bone grearly reduced as a result of dual resoption from the creast of ridge and pneumatization of the sinus after the loss of teeth. The sinus expands rapid than the crestal bone resoption. As a result the amount of available bone in posterior maxilla greatly decrease in height.

High occlusal forces

The occlusal forces in the posterior region are greater than in the anterior regions of mouth. The molars also have the hightes diameter and surface area to distributes load on wider bone area and reduces the strain on bone. To follow the narural scheme the implant support should be greater in posterior molar region thea other areas. Threfore the decrease in bone quality and quatity and increased forces should be consider in treatment planning by the following points.

1- Implant size

The stresses mainly occures at the creastal region which can be reduced by increasing the daimeter of implant. The length of implants provides adecuate implant bone contact to dissipate the load applied to the prosthesis so longe implants are recommended wherever bone height allowed.

2- Implant number

Implant number is the best method to decreses crestal bone sresses. As a general rule in this area, one implant for each missing tooth is indicated. If stress factor magnified two implants for each missing molar are recommended.

3- Implant design

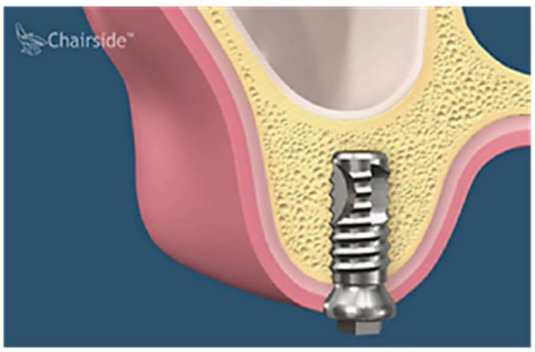
Implant design can increase surface area of support. A threaded design implant greatetr surface area than a cylinder implant od same size. Roughen surface conditions or hydroapitite coating increases the rate of osseointergation.

SUBANTRAL TREATMENT OPTIONS

The subantral treatment options depends on the available bone height between the floor of antrum and the creast of the residual ridge in the region of implant placement. The surgical approch, bone graft maretial and healing time is the main protocoles for subantral treatment options.

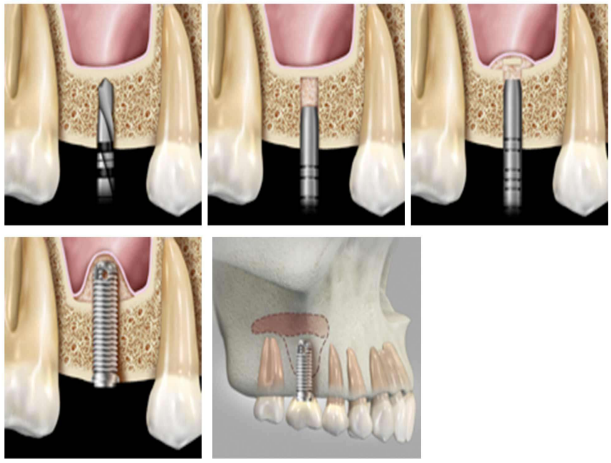
Subantral option 1: conventional implant placement

When there is sufficient bone, more than 12mm height, is available an endosteal implant is recommended. The healing time is 4 to 8 months depending on bone density. The commom rule to keep away 2mm from an opposing land mark in not applicable in SA-1 option as long as the sinus membrane in intact.



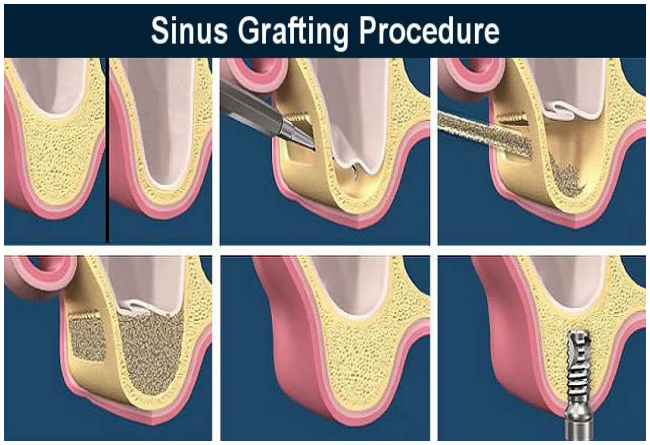
Subantral option 2: sinus lift and implant placement

When there is 10-12 mm of verticale bone is present (0-2mm less than SA-1) the SA-2 option is considered. In this option to get the 12mm or more bone height the antral floor is elevated through the implant osteotomy. The endosteal implant site is prepared. The depth of osreotomy is 1 – 2mm short of the floor of antrum. A cupped shaped osreotome of same diameter as of final osteotomy is selected. The osteotome is inserted in the implamt hole and tapped firmly in 0.5 to 1mm increments beyound the osteotomy untill is final position of 2mm. this causes a greenstick-type fracture in the antral floor slowly elevates the unprepared bone and sinus mambrane over the broad-based osteotome. This is claaed sinus lift. The implant is inserted in the osteotomy and slowly threaded into tho position. The apical portion of implant engages the cortical floor with bone over the apex and intact sinus membrane.



Subantral option 3: Sinus graft with immediate implant placement

When there is 5mm vertical bone is available between the antral floor and crest of residual ridge SA-3 option is recommended. In this option a Tatum lateral maxillary wall approach is performed just superior to residual alveoalr ridge. After the lateral wall acess window the mambrane are rotated upward in a superior position, a mixture of autogenous bone, alloplast or allograft material is placed in the space between the sinus floor anf elevated menbrane. When the rigde is more than 5mm in width, the implant may be placed at the time of sinus augmentation or may be delayed two or more months. There should be no history of sinus pathology, sinusitis and parafunction for immediate implant insertion.



Subantral option 4: Sinus graft healing and delayed implant insertion

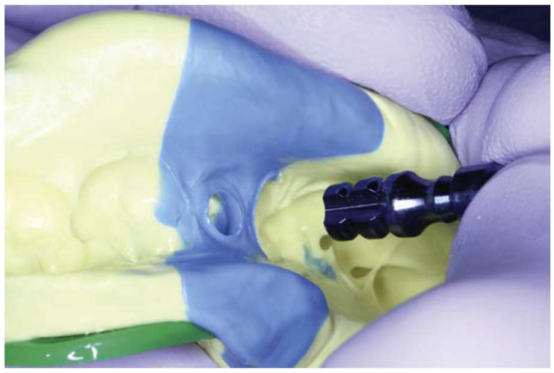
When less than 5mm bone remaines below the sinus floor SA 4 is applied. In the the sinus floor is lifted by the same method of SA-3 method. The graft is left for maturation for 6-10 months before implant placement.

IMPRESSION TECHNIQUES FOR IMPLANTS

There are two major techniques used for making impressions using impression copings. Each method is facilitated by a specific coping design.

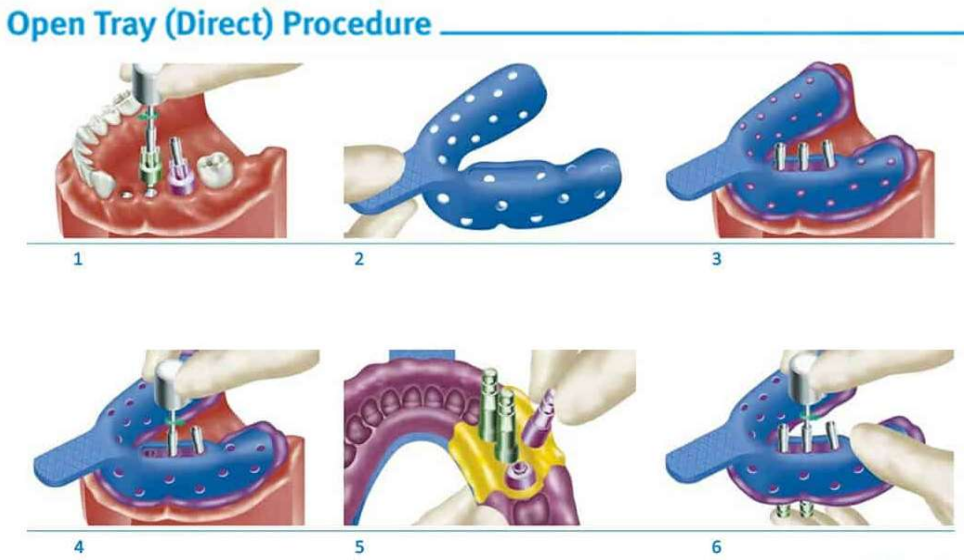
Transfer or closed-tray technique

The impression coping has a tapered shape and is attached to the implant or abutment, and it remains attached when the impression is removed from the mouth. The copings are then removed from the mouth and inserted into the impression. Analogs are attached to the impression copings before or after insertion, and the cast is poured. (Fig. 2.34).



Pick-up or open-tray technique

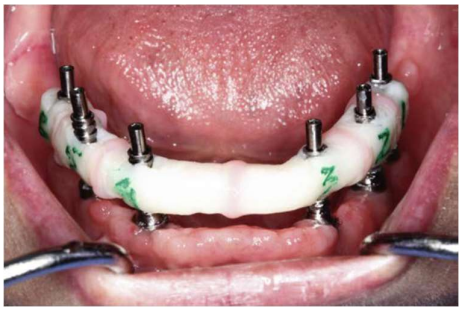
The impression coping features squares or other retentive elements and is attached to the implant or abutment before the impression is made. The screws, which retain the impression copings, project through the impression tray and are loosened before impression removal. The impression copings are removed with the impression, analogs are connected, and the cast is poured42 (Fig. 2.35).



Scanning abutments, or scan bodies

They are used when making digital impressions of implants using an intraoral scanner (Fig. 2.36). The scanning abutment is attached to the implant before the digital scan, and it is recognized by the scanning or design software to indicate the correct implant position.

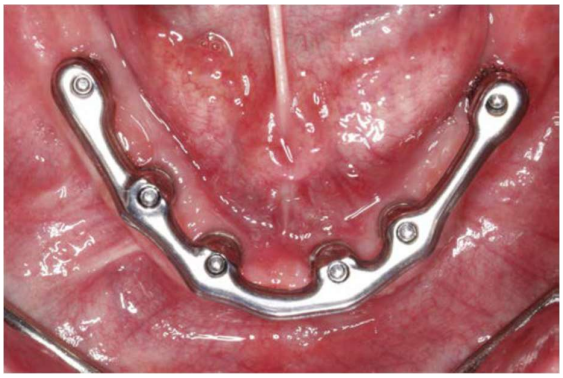
Implant verification jig (IVJ)



This is a device used to verify the accuracy of the master cast for an implant restoration. It consists of pick-up impression copings embedded in an acrylic framework and sectioned between the implants. The clinician then attaches each section to the implant, fuses the sections together intraorally, and provides the device to the laboratory for model verification (Fig. 2.37).

ATTACHMENT SYSTEMS

Overdenture attachments are mechanical devices used to provide retention between the removable prosthesis and the implants. For splinted overdenture cases, the attachments are normally incorporated into the design of the splinting bar. For free-standing implants, the attachments are often in the form of an abutment that attaches directly to the implant, such as a ball or Locator attachment.
Attachment system for implant overdentures is consisting of two parts; the Matrix being the receptacle part and a corresponding part Patrix, that fits closely within the matrix, either my mechanical or by friction fit. One part is connected with implant and other is incorporated in overdenture. Ball or magnetic attachment are easy way to retain implant overdentures and recommended when patient is wearing old dentures. The bar attachments are recommended in atrophic ridges and with more than two implants needs to connect together.



IMPLANT LOADING PROTOCOLS

Implant loading means the placement of restoration on the implants after healing. The restoration of dental implants consists of the procedures needed for the connection of a prosthesis to one or more implants. Restoration is accomplished using one of these basic loading protocols.

1. **Conventional loading*:*** Restoration is placed after the initial bone and soft tissue healing process, usually in 3 to 6 months, depending on bone density recommended in poor density bone.

2. **Immediate loading*:*** A prosthesis is connected at the time of implant placement. This is usually a provisional restoration that is replaced with a definitive restoration after implant and soft tissue healing. Implant placement with primary stability and prosthetic loading occurs at the same clinical visit. This is recommended in good bone density with initial stability of implant.

3. **Early loading*:*** The prosthesis connection occurs from 2 to 3 weeks after implant placement. This is considered to be a less predictable loading protocol because the restoration is sometimes placed during the stability dip, which is the period of lowest implant stability. Only recommended in D1 type bone.

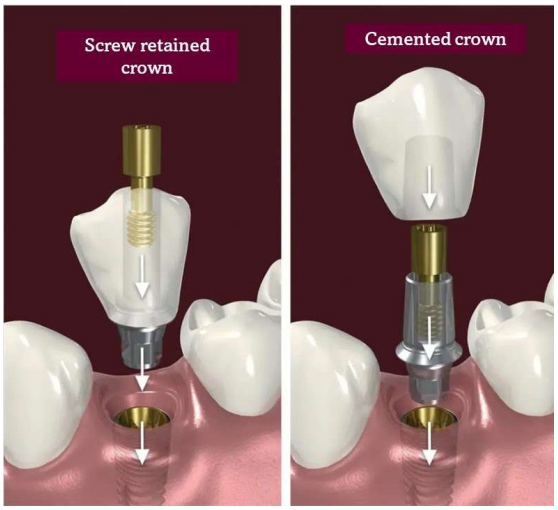
4. **Delayed loading*:*** The prosthesis is connected 6 to 12 months after implant placement. This method is often chosen in poor quality bone and in situations in which primary stability cannot be achieved during surgical placement.

SCREW-RETAINED VERSUS CEMENT-RETAINED RESTORATIONS

Fixed implant restorations may be ***screw retained*** or ***cement retained.***

Screw-retained restoration

The prosthesis can be attached to the implant directly, or indirectly, through the use of a standardized abutment. The screw retained indicated in reduced interocclusal space and can't accommodate an additional abutment over the implant. The crown is directly attached with the implant by a screw. The screw needed very precise and accurate fit without any error for passive fit no adjustment can be made during attachment. They are easy to retrieve.



Cement-retained restoration

The prosthesis can be attached to the implant abutment with the Zinc phosphate cement as conventional crown. A standardized abutment that has been modified for the specific case or, more commonly, a custom abutment that has been designed for the specific case is used. Custom abutments can be fabricated using a castable abutment, or through a computer-aided design (CAD)/ computer-aided manufacturing (CAM) process, and can be produced from titanium, gold alloy, or milled zirconia. Cement retained restorations are indicated where sufficient interocclusal space is available to accommodate the abutment. These abutments can be modified accordingly during cementation. They may accommodate the slight errors of casting.

PERI-IMPLANT DISEASE

Peri-implant disease refers to inflammatory reactions found in the soft and hard tissues surrounding an implant, and it is a well-reported complication of implant treatment.

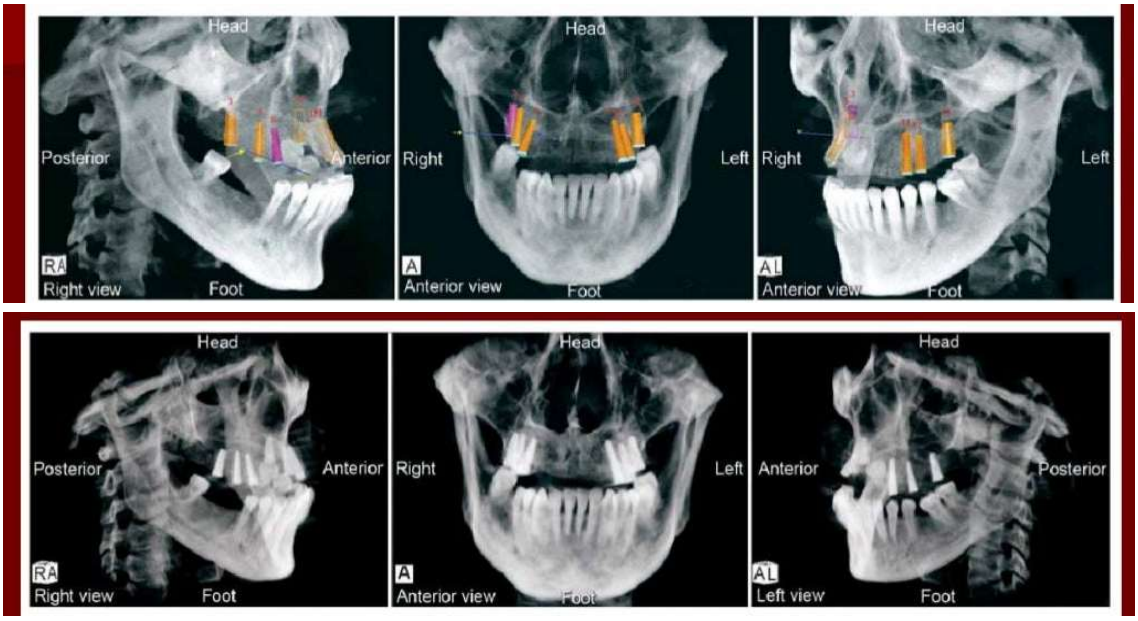
Peri-implant mucositis refers to the presence of inflammation in the soft tissue surrounding an implant with no signs of lost supporting bone.

Peri-implantitis describes an inflammatory process around an implant, characterized by soft tissue inflammation and loss of supporting bone. Tissue loss from peri-implantitis can result in the failure of implants and the associated prosthesis.

CBCT AND ICT IN IMPLANT DENTISTRY

One of the most significant advances in cone beam computed tomography (CBCT) technology is interactive computed tomography (ICT). ICT describes a technique that was developed to bridge the gap between the CBCT radiographic survey and the surgical placement of implants or bone
grafts. With this technology, the implant clinician's computer becomes a diagnostic radiologic workstation with unlimited tools to measure the length and the width of the available bone, determine bone quality, evaluate vital structures, diagnosis pathology, place type and specific sized implants, and evaluate and preplan the final prosthesis.
When viewing the data via the interactive software, various views may be obtained that include axial, cross-sectional, panoramic, sagittal, coronal, and three-dimensional (3D). Specific areas or regions of the patient's anatomy can be selected for display, which may be manipulated via magnification or grayscale modifications to facilitate the evaluation of anatomic structures, anatomic variants, or disease processes.
An important feature of ICT is the implant clinician may perform electronic surgery (ES) by selecting and placing various sized implants into specific anatomic areas. With an appropriately designed diagnostic template, ES can be performed to develop the patient's treatment plan electronically in three dimensions. Electronic implants can be placed at arbitrary positions and orientations with respect to each other, the alveolus, vital anatomic

structures, and the final prosthesis. ES and ICT enable the development of a 3D treatment plan that can be integrated with the patient's anatomy and visualized before surgery.



The implant clinician can determine the exact specifications of the implants with the number and size of implants, along with the density of bone at the proposed implant sites or bone grafting needed before surgery.

Recent advances have allowed this technology to go one step further, with the advent of navigational surgery. Navigational surgery allows the clinician to place implants precisely in "real
time" with specialized computer software and global positioning system (GPS)–like technology.

Therefore, with the help of ICT technology in implant dentistry, clinician can:

1. Evaluating and determining the ideal implant position prior to obtaining an CBCT,
2. Obtaining a CBCT scan,
3. Obtaining a dataset,
4. Integrating the dataset into interactive computer software programs
5. Developing various treatment plans with the CBCT data
6. Designing a surgical template from the treatment plan, and
7. Integrating the surgical plan/template into the actual surgical procedure.

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